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OF
SCIENCE.

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OF

SCIENCE:

CONTAINING PAPERS READ BEFORE

THE ROYAL DUBLIN SOCIETY;

THE ROYAL IRISH ACADEMY;

THE GEOLOGICAL SOCIETY OF DUBLIN;

AND

THE NATURAL HISTORY SOCIETY OF DUBLIN.

Edited by

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'Ο βίος βραχὺς· ἡ δὲ τέχνη μακρή· ὁ δὲ καίρος ὀξὺς· ἡ δὲ πεῖρα σφαλερή· ἡ δὲ κρίσις χαλεπή.—Hippocrates.

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SCIENCE.

I.—On the Organs which in the Common Ray are homologous with the Electrical Organs of the Torpedo. By Robert M'Donnell, M. D.

[Read before the Royal Irish Academy, December 8, 1860.]

The very beautiful structures which exist in the electric as well as the non-electric rays, as appendages of the anterior branches of the fifth pair of nerves, were regarded by Geoffroy St. Hilaire and others as the representatives of the electric organs of the torpedo. The fact, however, of their existence in the torpedo along with, although not united with, the electric organs, is sufficient to render this view untenable.

1. Savi, who has given an accurate description of them in the torpedo, as well as a beautiful drawing, considers them as an apparatus for the secreting of mucus. For reasons, however, not to be entered on at present, the view taken by Jacobson, Treviranus, and, more recently, by Leydig, that these are organs of sensation, seems the correct one.

2. The existence of the true so-called "system of the lateral line" in the electric, as well as the non-electric fishes, enables us also to set aside this apparatus as not being homologically related to the electric organs, as has been supposed by some authors.

3. The organ described by its discoverer, Dr. Stark, of Edinburgh, as an electrical apparatus, in the tail of the flapper skate and other rays, on account of its form and position, can hardly be considered the true homologue of the electric organ of the torpedo; nor am I aware that any of the authors who have examined it have, in their subsequent re-

searches concerning this tail-organ, put forth such a notion. Possibly the pseudo-electric tail-organs of the rays may yet be shown to be homologically related to the electric organs of the *Gymnotus electricus*.

I believe, however, that I have lately discovered in the non-electric rays the organs which are the true homologues of the batteries of the torpedo; and it is the object of the present communication to indicate the anatomical relations of these organs, and briefly to state how I have been led to make them out.

If the skin be carefully removed from the upper surface of the head and the anterior half of the back of a common skate, the following parts at once come into view:—

1st. The dorsal aspect of the branchial chambers.

2nd. A band of tubes filled with crystalline jelly (a bundle of the muciferous tubes of Savi), running from a centre, external to the gills, inwards, and a little backwards, but a little way behind the temporal orifice.

3rd. A muscle arising from the cartilage close to the posterior branchial arch, but nearer the middle line, and running forwards underneath the bundle of tubes just mentioned, to terminate in a long, delicate tendon, passing to the extremity of the snout.

If this bundle of tubes be raised, and drawn forwards, and the little fleshy belly of the snout-muscle drawn outwards, in the angle formed between them will be found the organ sought for; but probably it may remain invisible until a drop or two of tolerably strong acetic acid being brought in contact with it, it is thus revealed as distinct from the gelatinous tissue which surrounds it. Thus brought into view, we find a little mass, varying in length from $\frac{3}{4}$ of an inch to $1\frac{1}{4}$ inches, wedged in between the occipital muscles internally, and the branchiæ and their thin muscular coverings externally, covered superficially by the tubes and snout-muscle, already mentioned, and dipping downwards so as to reach the nerve-branches of the vagus going to the gills.

Viewed with the naked eye, this mass seems to consist of a number of quadrangular and pentangular bodies of somewhat irregular form and size, united together by areolar texture, and packed beside one another in a vertical position. Seen in the microscope, it is found to be composed of granular, nucleated substance, and larger cells of a peculiar character, seemingly more or less immediately connected with the nervous ramifications, the whole entangled in a very abundant areolar tissue. But it is to the nerves of this little body that I wish to direct special attention: its small size makes it at once obvious that its supply of nerves cannot be very large; yet, on careful dissection of large skates, I have found that it gets minute nerve-twigs from the branches of the vagus supplying the gills, and that it also receives a larger and more easily discovered branch from the fifth, which, on close examination, proves to be closely related to that which constitutes the first electric nerve of the torpedo.

Thus, as I have satisfied myself by dissection, as well as from Savi's beautiful plate and description, that the posterior branch of the fifth pair

in the torpedo, passing out from the cranium, immediately behind the temporal orifice, divides into four branches :—

1. For the muciferous tube system (of Savi).
2. For the mucous membrane of the mouth.
3. For the muscles of the jaws.
4. For the electric organ.

The same nerve in the skate, also to be discovered just behind the temporal orifice, gives off, immediately after escaping from the cranial cavity, similar branches, supplying—

1. A very large branch to the muciferous tube system (Savi).
2. The mucous membrane of mouth.
3. One to the muscles of the jaws from which the small branch,
4. Going to the organ just described, is derived.

On the following grounds, therefore, is based the opinion, that this little organ is truly the homologue of the electric organ of the torpedo: its position and relative anatomy, its structure, its nervous supply; and, moreover, that I have not found it present in the torpedo, which, through the kindness of Dr. E. Perceval Wright, I have had an opportunity of dissecting.

Let me state, however, with reference to this last assertion, that I am unable to say positively that the organ in question does not exist in the torpedo; for, in those which are to be found in the museums of Dublin, it is possible that they may have been removed in the dissections already made, which may also have been the case in that placed in my hands by Dr. E. Perceval Wright.

If further research shall show that these organs co-exist in the torpedo with the electric batteries, then, of course, the idea of them being homologous organs falls to the ground.

It may occur to some, also, as it did at first to myself, that the bodies which I have described may be related to the "follicular nervous apparatus" ("appareil folliculaire nerveux" of Savi), existing in the torpedo, but not in the non-electric rays; but I conceive that the consideration of the structure and nervous supply is sufficient to negative such a notion.

In that chapter of Mr. Charles Darwin's book on the "Origin of Species," in which he speaks of those difficulties on the theory of descent with modification, some of which are so grave, that he tells us that to this day he cannot reflect on them without being staggered, and which have much more than staggered many of his readers, the learned author mentions the electric organs of fishes as a case of special difficulty.

Here was a case, indeed, of special difficulty, obvious to every reader. How, on the view of common descent, could we conceive, that while these wondrous organs were brought to such a condition of development and power in the torpedo, that in the immediate members of the same family, no trace of such structures was known to exist?

It seemed impossible, or at least in the highest degree improbable, that if the Raiidæ had, in even countless ages past, sprung from a common ancestor, the electric batteries of the torpedo should be without

their homological representatives in other rays. Yet no candid inquirer could grant that either the mucous tube apparatus, the lateral line system, or indeed the pseudo-electric tail-organs, fulfil the necessary conditions.

Considering, then, the great size and peculiar origin of the nerves going to the electric organs of the torpedo, it seemed that a very close and accurate dissection of the corresponding nerves of the skate was likely to afford some clue to any atrophied or modified electrical apparatus, if any such existed in that animal: by following this course, I have made out the organs already described.

II.—On a Theorem relating to Conical Surfaces. By Professor Hennessy, F. R. S.

[Read before the Royal Irish Academy, November 12, 1860.]

The Theorem is announced as follows:—"If a cone of maximum volume, under a given conical surface, roll on a plane with its vertex constantly touching a point in the plane, the interior envelope of the cone will be a second cone which possesses the property of containing a maximum volume under its total surface."

If we denote by θ_1 the angle at the summit of the cone of maximum volume under conical surface, and by θ_2 the corresponding angle for the cone of maximum volume under total surface, we shall have

$$\sin \tfrac{1}{2}\,\theta_1 = \frac{r_1}{l_1}, \qquad \sin \tfrac{1}{2}\,\theta_2 = \frac{r_2}{l_2},$$

r_1, r_2, being the respective radii of the bases, and l_1, l_2, the respective slant heights of the cones.

By the usual methods we easily find

$$r_1 = \frac{1}{\sqrt{3}}\,l, \qquad r_2 = \frac{1}{3}\,l.$$

Whence

$$\sin \theta_1 = \frac{2\sqrt{2}}{3} \qquad \cos \tfrac{1}{2}\,\theta_2 = \frac{2\sqrt{2}}{3}$$

Consequently, if β represent the angle at base of the cone of maximum volume under total surface, we shall have

$$\sin \theta_1 = \sin \beta.$$

The angle at the summit of the cone of maximum volume under its conical surface is, therefore, equal to the angle at the base of the cone of maximum volume under its total surface, and the theorem announced immediately follows. It also readily appears that upon the same base the cone of maximum volume under total surface is double that of maximum volume under conical surface.

III.—On a new Compound Microscope. By Thomas Grubb, Engineer to the Bank of Ireland.

(Plate I.)

[Read before the Royal Dublin Society, March 26, 1858.]

The instrument to which I have the honour of drawing your attention this evening will be recognized by some present as having the same general and peculiar form of that which I had devised and constructed some years since, and previous to our (Dublin) Microscopic Society having merged into the "Natural History" Society.

The instrument in its original state included, indeed, the advantages of extreme steadiness, an improved fine adjustment for focussing, and improved safety-tube for the object-glass, with the means of viewing objects (placed on a horizontal stage) at the most comfortable angle for vision. But it is the peculiarity of the instrument, in its present state, that it removes all necessity for that subsidiary and costly apparatus for illumination which those microscopists who pursue delicate microscopic research find it necessary to provide, in addition to the microscope *proper;* and not only this, but the present instrument enables the observer to apply, with a facility otherwise unattainable, without removing the eye from the instrument, without any changing of parts, and by simply moving its one illuminator on its sector, every kind of illumination, *seriatim*, to an object placed upon the stage of the instrument. It does more than this; for it enables the observer, when he has produced any appearance or effect by the illumination which he desires to be able to reproduce at pleasure, to register the same, so that he can either resort with certainty to it at a future time, or communicate the particulars to a friend, who, if possessed of a similar instrument, can do likewise.

The subsidiary apparatus for illumination of a well-furnished microscope usually includes a set of achromatic condensers, the prism of Amici, the parabola of Shadbolt, and Bergin's addition to the latter for oblique illumination. It is unnecessary to go into any detail of the trouble experienced, and the time frequently consumed in obtaining, with the assistance of one or more of these appliances, a satisfactory illumination. These drawbacks are well known to microscopists. For the information of others, I may state, that frequently five minutes of very eye-teazing work, and sometimes three times that, are devoted to obtaining a satisfactory result, which, after all, is liable to be undone by an incautious touch of the mounting, and which is only to be restored by the same tentative process of the previous adjustment.

It was such experiences as these which led to the improvements combined in the present instrument. A little consideration was sufficient to show that, assuming we are in possession of an illuminating pencil of unexceptional quality for every kind of illumination required, then every kind of such, including the illumination of opaque objects, will be comprehended under two heads,—viz., first, the means of applying such

illuminating pencil at all angles with respect to the plane of the object (or the stage of the microscope); secondly, the means of applying the pencil at all azimuths of same.

This generalization, so to speak, of the illumination, indicated the means of carrying it out effectually. I had previously ascertained, from direct use, that an achromatized prism was capable of giving every kind of illumination required, in a manner not surpassed by other means extant. Rejecting the difficult matter of causing the illuminating pencil to move in azimuth round the object, I devised the present stage, which, while it is made to revolve, has those objections to revolving which appertain to other stages removed; and, by making a little variation in the manner of attaching the body (or tube) of the instrument to its arm, means are provided for readily bringing the optic axis of this tube to pass through the centre of revolution of the stage, and thus all objection to revolving the object, instead of the light, is got rid of.

For the other movement of the prism (or that vertical to the plane of the stage), I have, as may be seen, adopted a sector, on which the carriage containing the prism, and including the ordinary adjustment for focussing, and a small azimuthal movement for modifying the illumination slides. This sector is attached to the same piece which carries the stage, and so that its centre, if produced, would cut the optic axis of the tube, where an object mounted upon a glass slide of the ordinary thickness, and laid upon the stage of the instrument, would be. A prism, or other object, being simply moved round on a sector so placed, will evidently remain unchanged in its distance from that central point.

In constructing the illuminating prism, it was to be recollected that there was but one direction in which the light could be placed, viz., in the plane of the object, or say $\frac{1}{10}$th of an inch above the plane of the stage, and vertically to the sector's plane; and, secondly, that the distance of the light from the stage must be assumed. The prism, therefore, necessarily reflects the rays through a greater angle than 90°, and its reflecting surface usually requires silvering. This has been assumed to be an objection; but the light is still more than ample, as well as beyond that given by most other illuminators, the prism having (although a triple combination) only two uncemented surfaces. I have, from my own experience, adopted a distance for the source of light of about 15 inches, as most useful for general work; but should a distance of two feet or upwards be selected, then the prism may be one of total reflexion, and its reflecting surface consequently remain unsilvered.

The manner of using the instrument is shortly as follows:—The microscopist will, of course, place it as he would any other microscope, conveniently on a table, and incline it to the desired angle for work. The lamp, or other source of light, is to be placed directly opposite, and in front of the instrument, and at the proper distance and height, the distance being always the same, and the height that which brings the light into the plane of the upper plate of the stage. The adjustment may be verified and corrected as follows:—Place a slider with a grayed surface on the stage (grayed surface upwards); move the prism to the lowest

point of the sector (or to zero), and turn it directly outwards, or towards the light; adjust the distance of the prism from the grayed surface, so that an image of the light is formed upon the latter; and, looking through the tube of the instrument (the lenses being removed), observe if the image formed on the grayed glass be central with the tube; if not, make it so, by a slight alteration in the inclination or azimuth of the instrument, without varying its distance from the light. It is by no means necessary to make these adjustments accurately; but the more accurate they are, the more perfectly will the image on the grayed surface *only revolve*, and without change of place, on moving the prism on the sector. It is, perhaps, unnecessary to observe that the microscope, without making any of these adjustments, may be used in the same manner as, and with all the convenience of, an ordinary instrument, while, by making the adjustments as described, we obtain the peculiar advantages sought for in the construction.

These advantages may be shortly summed up as follows:—An object being placed upon the stage, and the focus adjusted, the observer can examine it under every azimuth of illumination, by revolving the stage, and under every possible kind of illumination in each azimuth,—viz., direct transmitted light, oblique transmitted, dark-ground illumination, and, finally, the illumination for opaque objects, by simply moving the prism on the sector; and he can do all this without once removing his eye from the eye-piece; while the quality of the illumination, in all its varieties, is such as is not surpassed by other more or less special contrivances. Indeed, the general impression of those who have used the instrument is, that its illumination is more effective, particularly in showing the delicate details of difficult objects, than any other extant.

Lastly, and not least, is the power of reading off on the sector the angle of the illumination used, whereby the effects of different angles of illumination can be registered, resorted to again at pleasure with certainty, or communicated to other observers, enabling them to do the same, if provided with a similar instrument.

Perhaps I may be permitted to conclude this imperfect description by mentioning what one, who is well qualified to judge of the merits of the instrument, has communicated respecting it. He quaintly says, "I find but one fault in your microscope; and that is, that it puts me out of conceit with the using of any other."

REFERENCES TO PLATE I.

AA. The base (of mahogany).
B. One of the two brackets of support.
C. One of the two milled heads for clamping the instrument at the desired inclination for use.
D. One of the milled heads for course adjustment of focus, acting upon a strong triangular bar (not seen in the engraving).
E. Illuminating prism.

F. Milled ring for adjusting by hand the *azimuth* of the prism.
G. Slide, with rack and pinion, for adjusting the *distance* of the prism from the object.
H. Sector (seen also at *h*) on which the prism is moved by hand through any required arc concentric with the object on the stage.
I. The stage; *ii*, upper and lower milled rings, which produce, on being turned by hand, the slow motions, in two directions, of the object-plate of the stage.
K. Bracket-piece, supporting the stage, and also the plate for carrying the polarizer when required.
L. Toothed wheel with pinion and milled nut for revolving the stage in azimuth.
M. Dovetailed slide, carrying both stage and sector with the illuminating prism. A screw and its bent lever (the latter passing to the back of the instrument) are partially seen at N; and at O is a spiral spring, which keeps the slide M in close contact with the screw N. The lever N is equally available to either hand at the back of the instrument; PP are opposing screws, which serve to bring the optic axis of the body or tube Q to coincide with the centre of revolution of the stage, Q being purposely not *screwed* (as usually) into the projecting arm, but held (with a sufficient amount of lateral movement) between the collars *rr*.

IV.—On the Condition of the Irish Agricultural Labourer. By Thomas Baldwin, Lecturer on Agriculture, Albert Model Farm, Glasnevin.

[Read before the Royal Dublin Society, February 24, 1860.]

I have been invited to assist in eliminating some conclusions from the voluminous answers given to the large number of questions issued last year by this Section of the Royal Dublin Society. The range of subjects and interests embraced by these queries and answers is so comprehensive, that on the present occasion I shall only attempt very imperfectly to follow up Mr. Hamilton's able introductory paper, and confine myself to one or two salient topics, leaving for future discussion the great principle of agricultural statistics which the queries involve. The most important subject on which information was solicited in the queries is the labour question; and, whether we regard that question as it affects national wealth, social harmony and organization, or the profits of arable farming in Ireland, it is deserving of the most profound consideration.

It is universally admitted that up to a recent period the Irish farm labourer was badly paid. He contrived to eke out a miserable subsistence. His fare was often of the poorest kind, his dwelling a wretched hovel, which his employer rarely stooped to enter. No one save the clergyman ever brought a ray of cheerfulness to the hearth of the hard-wrought son of toil. I well remember the circumstance of a couple of

parishes, owned by three proprietors, where the average wages of the able-bodied agricultural labourer varied from an average rate of 6*d.* a day in one, to 8*d.* per day in summer, and 7*d.* in winter, in another. In the former case, the men had to travel a mile to their work in the morning, which compelled them to rise before 5 o'clock A. M., and the same distance to their dreary homes in the evening. The man's wife, or, if she was fortunate enough to be on the labour roll, a daughter or a son, who should leave school, had to walk these same two miles with the man's dinner. The hours of labour were from 6 A. M. to 6 P. M., an hour being allowed for meals.

The labour of these men was apparently obtained at a very low rate; but, had any of the employers the head or the heart to conceive and feel his position, he could procure the same amount of actual force or motive power by paying the men wages competent to maintain their muscles in an efficient state. At that time the supply of labour was excessive; and, by an unwise policy, its quality deteriorated in the inverse ratio of the surplus.

The famine, and the tide of emigration which it set in motion, and which still continues to flow at a pretty steady velocity, have completely altered the state of the agricultural labour market in Ireland. Instead of a redundancy, there appears in many districts a scarcity; and, judging from passing circumstances, it is greatly to be feared that the supply of able-bodied labourers in this country will, ere many years elapse, be so far weakened as to increase to an undue extent the breadth of land under permanent pasture. We have each year a fresh accession of labour in those who advance from youth to manhood; but a large number pass away from the stage of human existence, and the emigrant ship bears away to distant lands, annually, thousands of the very best agricultural labourers which the country produces. These statements are forcibly confirmed by the official returns of the Registrar-General. In 1858—

The number of deaths was, ...	133,000
,, who emigrated (Irish), . . .	64,337
	197,337
The number of births, ...	193,347
Decrease in population, ...	3,990

It appears to me that the time has arrived when those who are deeply interested in the prosperity of Ireland should seriously reflect on the effects that may be expected ultimately to emanate from the present tide of Irish emigration. If not stopped in due time, "none but decrepit paupers will be left to till the land," which would then necessarily revert to a pastoral state. The emigration of a portion of our population was perhaps necessary. It materially tended to shatter those ties which bound the labourer to a particular spot almost as firmly as a parasite plant clings to the trunk on which it lives,—ties which induced Adam Smith to say that "man is, of all sorts of luggage, the most diffi-

cult to be transplanted." But emigration has its limits. Labour is the primary source of wealth; and as the wealth of Ireland is principally derived from agricultural labour, it follows that the emigration of a large portion of our able-bodied and most efficient working men must materially militate against the industrial progress of this country.

In order to check this emigration, it is quite evident we must give the labourer adequate wages, and afford him decent accommodation. The country at large must adopt the wise and salutary example of Mr. Naper, of Loughcrew, who gives his men higher wages than most of his neighbours, and who assured me some time ago that an increase of two or three pence a day to the labourer's pay was soon perceived in the increased labour executed. Mr. Naper is a gentleman imbued with the highest and purest motives of philanthropy, and, as he can afford to experimentalize, it may be said that the tenant-farmer cannot follow him in a matter of this kind. Now, it is necessary to make a distinction between the affluent country gentleman who cultivates a home farm as an expensive luxury, and the tenant who farms for profit. But in considering a great public question like that which engages our attention this evening, we must give due weight to all well attested facts, no matter, whence they proceed.

The average weekly wages of able-bodied men, women, and boys, in the several districts from which answers have been received to the queries, are as follows:—

County.	District.	Weekly Wages.		
		Men.	Women.	Boys.
		s. *d.*	*s.* *d.*	*s.* *d.*
Antrim, ...	Ballycarey, ...	9 0	4 0	3 0
Antrim, ...	Ballymoney, ...	8 0	– –	3 0
Cavan, ...	Bailieboro', ...	8*s.* to 9*s.*	5 0	2*s.* to 7*s.*
Down, ...	Moira, ...	7 0	4 0	3 0
Down, ...	Newry, ...	6 6	– –	– –
Monaghan, ...	Bath, ...	6 0	3*s.* to 4*s.*	3 0
Tyrone, ...	Loughash, ...	6 3	– –	4 0
Kilkenny, ...	Kilkenny, ...	7 0	3 0	3 0
Cork, ...	Farnahy, ...	6 0	– –	– –
Cork, ...	Glandore, ...	7 0	– –	– –
Limerick, ...	Croom, ...	6*s.* to 9*s.*	3*s* to 4*s.*	2*s.* to 4*s.*
Mayo, ...	Between Headford & Ballinrobe, . . .	5 0	2 6	2 6
	Averages, . . .	6*s.* 11½*d.*	3*s.* 7½*d.*	3*s.* 2½*d.*

Compared with the ratio of wages paid up to the period of the famine, these averages are exceeding liberal. But are they adequate to sustain the working man in that state of strength and vigour in which he can execute a good day's work? In answering this question, we can pursue two distinct lines of reasoning. The one may be theoretic, and based on abstract scientific facts, deduced from the experimental investigations of

the physiologist; the other is practical, and deals with the experience and opinions of distinguished practical agriculturists, who have carefully considered the subject. As the papers of Mr. Hamilton and Rev. Mr. Hickey profess to deal with the subject in the latter respect, I shall for the present merely offer a few remarks on the former, and chiefly with the view of eliciting the opinions of the employers of labour.

It is exceedingly difficult to arrive at an accurate conclusion as to the amount of the absolute necessaries of life demanded by an agricultural labourer. "The poorest labourer," says the author of the "Wealth of Nations," "must, one with another, attempt to rear at least four children. But the necessary maintenance of four children, it is supposed, may be nearly equal to that of one man. Thus far seems certain, that in order to bring up a family, the labour of the husband and wife together must, even in the lowest offices of human labour, be able to earn something more than what is precisely necessary for their own maintenance." Granting that the labour of the wife is sufficient to provide for herself, which does not always happen, and that the labourer's wages must, on an average, not only support himself, but a number of children, whose joint consumption of food equals his own, let us consider the adequacy of the wages of the Irish agricultural labourer.

Taking the average wages of an able-bodied labourer at 7*s.* per week, —the one-half of it is 3*s.* 6*d.*, from which we are to deduct 1*s.* 6*d.* a week for clothing and cottage rent, leaving only 2*s.* a week to supply the man's food. This sum is really inadequate to maintain a working man in an active state.

The body of the labourer has been aptly compared to a machine. The comparison may not appear appropriate. It will, perhaps, be called a sordid comparison; nevertheless, it will be found that we are consulting the best interests of the labourer if we show his employer that it is his interest to bestow upon the animal machine only as much attention as is paid to the farm-horse or the steam-engine. The steam-engine will not give out its full power unless the furnace is well supplied with coal; and so it is with the labourer, who cannot produce a full complement of units of force, unless we supply in his food the carbon necessary to carry on the combustion that takes place in his body. The steam-engine refuses to move as soon as we neglect to execute the repairs of any part worn away; and so it is with the working man, who cannot continue to ply his arm actively, unless his food contains a sufficiency of nitrogen to supply the waste of his muscle produced by the physical force which he exerts.

V.—On the Occurrence of Nickeliferous Magnetic Pyrites from Tiernakill, near Maum, County of Galway. By the Rev. Samuel Haughton, F.R.S., Professor of Geology in the University of Dublin.

[Read before the Geological Society of Dublin, June 13, 1860.]

The royalties of the estate of the Provost of Trinity College in the county of Galway having been leased to Mr. Hodson, of well-known mining ce-

lebrity in the county of Wicklow, this gentleman has proceeded to develop the resources of this part of the county of Galway with his accustomed skill and success. Six lodes have already rewarded his enterprise, viz.:—

1. Main lode: 20 ft. wide, containing sulphur and a little copper ore.
2. North lode: 12 ft. wide.
3. Cross lode: in places seen 20 ft. wide, containing sulphur, copper, and particles of lead ore.
4. East and west lode: 30 ft. wide, containing a little sulphur ore.
5. South lode: 20 ft. wide, with a most beautiful appearance of sulphur and copper ore.
6. Iron lode: seen at surface 30 fms. wide.

The sulphur ore from these lodes was carefully examined by Mr. M'Dowell and myself, in October last and in May, with the following results:—

First Analysis.

Chlorite, ...	0·25
Iron, ...	60·41
Copper, ...	0·21
Nickel, ...	0·07
Sulphur (diff.), ...	39·06
	100·00

Second Analysis.

Chlorite and Quartz, ...	11·85
Iron, ...	52·44
Sulphur, ...	35·70
	99·99

From these analyses, it is evident that the ore is magnetic pyrites, containing traces, though unquestionably genuine, of copper and nickel; which latter valuable metal, it is to be hoped, will occur in greater quantity as the mining operations descend. From the two analyses, it appears that the proportion of atoms of iron and sulphur are:—

	1st Analysis.		2nd Analysis.	
Iron, ...	2·16	7	1·87	6
Sulphur, ...	2·44	8	2·28	7

These are proportions commonly recorded for this mineral. I believe myself that the mineral is probably a protosulphuret of iron, with a slight mechanical admixture of iron pyrites.

The lode containing the magnetic pyrites bears N. 76° W. by compass, and, if prolonged, would pass probably into the townland of Barrowgarriff, the minerals from which have been reported on by Dr. Apjohn.

The true bearing of this lode is W. 12° S. The veinstone is quartz and chlorite, so well known to Cornish miners as "Peach."

Another of the lodes, known as the Iron Lode, bears N. 65° E. by compass, or N. 39° E. (true), and contains large masses of red massive garnet, similar to that found in lodes at Botallack, in West Cornwall, and brown iron ore, the veinstone being, as before, quartz and chlorite; it is between 20 and 30 yds. wide.

The intimate connexion between this estate and those of Lords Charlemont and Leitrim, and the certainty that some of the east and west lodes pass from Tiernakill into Carrowgarriff, give great interest to the following Report of Dr. Apjohn, published in connexion with the sale of the Rosshill estate, which I here reproduce:—

"*Analysis of, and Report upon, certain Minerals found upon the Estates of Lords Charlemont and Leitrim, in the Diocese of Joyce Country, County of Galway.*

"The minerals above referred to were placed in my hands on the 10th of January, and having just completed my examination of them, I lose no time in reporting the results at which I have arrived.

"Those of the minerals having a commercial value are the ore of lead, known under the name of Galena, and two specimens of iron pyrites (mundic or sulphur ore).

"The Galena occurs in two forms, as distinct crystals, which are cubes, modified by the faces of the octohedron, and in lamellar patches attached to massive quartz, which has all the appearance of having been a portion of the gangue or veinstone of a lode.

"The cubic crystals had attached to them a small quantity of ferruginous earthy matter, which could not be completely separated by mechanical means, and the constituents of which appear in the following analysis:—

COMPOSITION OF LEAD ORE.

Sulphide of Lead,	94·47
,, Zinc,	2·32
Peroxide of Iron,	2·85
Carbonate of Lime,	0·30
,, Magnesia,	0·06
	100·00

"The lead ore, therefore, contains of pure galena 97·6 parts in 100, and includes 84·53 per cent. of metallic lead; with this there is associated 1·6 of metallic zinc; but in the smelting of the lead this is lost, and cannot, therefore, be taken into account as enhancing the value of the

galena. This ore was very accurately examined for silver by cupellation, and the result was 10·53 ounces of silver per ton of lead.

"MASSIVE PYRITES OR SULPHUR ORE OF A YELLOW COLOUR.

"This specimen was associated with a small amount of gangue, and had nearly as yellow a colour as the common ore of copper; it was altogether massive, none of it occurring in distinct crystals. Upon analysis, it yielded the following results:—

Sulphur,	35·36
Arsenic,	0·92
Iron,	42·34
Copper,	0·32
Quartz of Gangue,	20·32
	99·26

"From this analysis it is easy to infer that the specimen of pyrites for every two equivalents of iron contained three equivalents of sulphur, a minute quantity of the latter element being replaced by arsenic. Its constitution would, therefore, seem peculiar, being intermediate, as respects the relative proportions of the sulphur and iron, between the ordinary sulphur ore and the conformation of the same elements which constitutes the mineral known under the name of Magnetic Pyrites. Subsequent experiments, however, showed that one-fourth of the iron was present as silicate of the protoxide, which removes the singularity just adverted to, and makes the composition of this specimen the same with that of ordinary mundic. If free from gangue or adhering silicate, it would contain 44·87 per cent. of sulphur, and would, therefore, be a very valuable material for the production of the oil of vitriol. It could be conveyed with facility from the locality in which it is found by water carriage along Lough Corrib to Galway, and, if exported from thence, it would, no doubt, like the sulphur ore of Wicklow, meet with a ready sale in Lancashire and Glasgow.

"IRON PYRITES IN CUBIC CRYSTALS OF YELLOWISH WHITE COLOUR.

"Of this ore I received two specimens, having, however, the same physical characters, so that it was not necessary to submit more than one of them to analysis. In 100 parts it was found to consist of—

Sulphur,	39·68
Arsenic,	0·16
Iron,	37·44
Gangue (quartz),	20·08
Loss,	2·64
	100·00

"It is, therefore, in point of composition, very analogous to the sul-

phur ore whose analysis was previously given, the principal difference being, that it contains a larger relative amount of sulphur, and somewhat lower per-centage of arsenic.

"The minerals whose composition has been just given were picked up from the ground or broken from the surface rocks by a gentleman unacquainted with mineralogy or mining, and were all found by him on the townland of Carrowgarriff, a part of the Rosshill estate. In examining with care this portion of the property, he was enabled distinctly to trace out two metallic lodes, one of which ran north and south, while the other pursued a westerly course in the direction of Leenane, situate on Killery Harbour. The former lode, he states, would, if prolonged, cross southward an arm of Lough Corrib, and pass into the district in which Mr. Hodson has recently commenced mining operations. Under these circumstances there can, I think, be no doubt that this district is metalliferous, and that, many years before, lead and sulphur ore, at least, were successfully wrought in it.

"With the metallic ores I also received a mineral having the appearance of talc, and which occurs in quantity on the townland of Cleggan, adjoining Carrowgarriff, and to the east of it. This substance, though, probably, destitute of commercial value, is as a mineral so new to me, that I venture to make brief mention of it in this Report.

"It is white with pearly lustre, lamellar in structure, like mica, the plates, however, of which it is composed not being parallel, but intersecting at all possible angles; it is very easily scratched, but is, nevertheless, materially harder than talc or gypsum; its specific gravity is 2·804; in thin scales it is slightly translucent. Before the blow-pipes it is indissoluble, and muriatic acid has no action on it. Upon analysis it gave:—

Silex,	45·24
Alumina,	37·89
Lime,	0·32
Magnesia,	0·30
Potash,	7·55
Soda,	2·92
Water,	6·60
	100.82

"This mineral is particularly remarkable for containing nearly ten per cent. of the fixed alkalies, the potash being to the soda in the ratio of 5 to 2. Though very similar in appearance to talc, in composition it differs widely from it.

"I may, in conclusion, mention that the masses of the substance just described, which were forwarded to me, were penetrated by numerous prismatic nodules of a rare mineral, first found in Andalusia, and hence known to mineralogists under the name of Andalusite. It (the Andalusite) has also been analyzed, and found to have a composition quite the same with specimens from Spain, and those occasionally found in the granitic districts of Dublin and Wicklow."

VI.—On the Wolfhill and Modubeagh Coal-fields, Queen's County. By George M'Dowell, Fellow of Trinity College, Dublin.

[Read before the Geological Society of Dublin, June 13, 1860.]

The Wolfhill, Mullaghmore, and Modubeagh Collieries lie in the north-eastern part of the Leinster Coal-field, a few miles beyond Ballylinan, on the road from Athy to Castlecomer. They have been hitherto worked as separate mines, and in a most unminerlike and unprofitable way.

So long ago as 1814, Sir Richard Griffith, in his Report on this district, says of the Wolfhill Colliery, that it is unwatered by a level which has been driven into the hill at a considerable expense; but the field of coal commanded by it is trifling; while the Ballylehane coal has only been worked where it was shallow; and the deep part remains untouched. As the coal-bed which occurs in these fields is the same, being the first slate-coal of Sir R. Griffith, and as there is nothing to prevent the joint working of them all on a uniform plan, I thought it might be interesting to those members of the Geological Society who take an interest in mining matters to have a short account laid before them of these collieries, and of the plan on which it is now proposed to work them on a joint system.

The coal-bed which occurs in them has been traced by Sir R. Griffith on the east side of the Leinster Coal-field from Wolfhill; on the north, by Ballylehane, Corgee, Poulitean, and Rushes, to Courlean and Clogrenan on the south. The eastern outcrop of this bed of coal, in the part of the Leinster Field under consideration, is shown on the map by the pits at Mullaghmore, Trial Pit, Hanlon's Pit, and Tully's Pit; and the coal is probably separated from the Glen Colliery, to the south, by a series of cross faults or hitches running east and west. The Wolfhill Colliery is separated from that of Mullaghmore, Modubeagh, and Ballylehane by a north and south fault, with a downthrow to the east of probably 90 or 100 yards. This fault divides the whole coal-field into an eastern and western division, which will be worked by distinct pits. The dip in both is to the south-west, but less in Wolfhill than in Modubeagh, being about 1 in 13 in Wolfhill, and as much as 1 in 7 in Modubeagh.

The unwrought portion of the coal in the two fields is shown on the map by the dotted area, which it is now intended to work by a systematic course of mining operations devoted to the extraction of the entire coal of both the eastern and western divisions of the district.

The good coal of the seam is from eighteen to twenty inches thick. It burns easily, and is very free from sulphur. It rests upon a bed of fire-clay of good quality, varying from two to three feet thick. This contains Stigmariæ, converted into iron pyrites, but still retaining on their surface the characteristic pittings of the tree of which they formed the root. The fire-clay, no doubt, was the soil in which the coal-plants grew. The roof of the coal is dark fissile shale, and abounds with various forms of Lepidodendrons.

The coal-field which I have thus brought before the notice of the Society, in a country abounding in coal, would, probably, be of little value from the thinness of the seam; but in a country like Ireland, where fuel is scarce, and, consequently, of high price, it is well worth while to direct attention to mineral resources, which, although not great, may, nevertheless, be made to yield a profitable return to capital expended with skill and economy.

VII.—Geological Description of the District extending from Dungarvan to Annestown, County of Waterford. By W. B. Brownrigg, S. T. C. D., and Theodore Cooke, C. E.

(Plate II.)

[Read before the Geological Society of Dublin, May 9, 1860.]

The section which we have the pleasure of laying before the Society, commences on the crest of the hills of which Helvick Head is the termination, and which separates the district around Dungarvan from the Vale of the Blackwater.

This section runs nearly east and west, its total length being twenty miles; but the line over which our observations extended, principally along the coast, is seventy miles.

Our examination ranges over a very barren kind of country, which is formed of a wide Carboniferous basin, reclining in and flanked on both sides by a similar basin of sandstone, succeeded by Silurian and alternating Igneous rocks, which extend eastward as far as Tramore, the ground rising gradually from Dungarvan, and the coast being very bold, rocky, and storm-shattered.

We do not know if the idea is original; but we have represented the geological features of the coast by supposing two planes at right angles to each other,—one vertical through line of section, while the other is horizontal, and forms a continuation of the sea-level; and then, ideally removing the mass of earth so cut away, thus exposing to one view the dip, strike, and planes of bedding, with the undulations of the hills, and contour of the coast (*vide* Plate II.). On the representation of this compound section, there is an interval left blank along the line of intersection of the planes, on which we have recorded our principal observations of strike and *corrected* dip, which will appear by simply laying out the section on the level.

Commencing with the Old Red Sandstone, we searched particularly for any traces of plants, with reference to Sir R. Griffith's Carboniferous base line; but they do not seem to occur in this locality. The stratification is formed of fine-grained purplish Sandstone shale, alternating with micaceous sandstone, often containing ferruginous amygdaloidal cavities. The sandstone is contorted at this point, forming a distinct anticlinal axis.

The shales and sandstones become lighter in colour as we ascend the series towards the Yellow Sandstone, which latter is often much weathered, and showing secondary lines of deposition.

There is nothing worth recording in the Lower Limestone Shale which occurs next, and we pass to the more immediate neighbourhood of Dungarvan.

Dungarvan has been lately brought into geological notice by its limestone caves, which are, in many respects, similar to those of Mitchelstown and Mapstown, having their representatives in the mountain Limestone of Derbyshire, Devonshire, and Adelsberg.

To illustrate the extent to which some of the caves of this formation in the South of Ireland stretch, we may mention that, at Nicholastown, a cavern, similar to that at Dungarvan, occurs, *two miles* in length. In these caves at Dungarvan, great quantities of bones were lately found by Mr. E. Brennan,—consisting, according to Dr. Carte's identification, of those of mammoth, bear, rein-deer, horse, hare, &c., &c. Mr. Brennan's paper on the subject was published last year in the Journal of the Royal Dublin Society Dr. Carte has kindly permitted us to see these remains, now deposited in the Museum of the Royal Dublin Society, and states that he has not been able to observe traces of gnawing upon any of them, which seems to support the view of the absence of predatory agency as a means of transport, in this instance at least. We were not fortunate enough, during the short period we spent in the locality, to find any similar remains; but we observed some of the usual fossils of the Lower Carboniferous Limestone, both here and further on along the coast at Bayview, of which the following were the principal:—

Euomphalus pentangulatus.
Producta Scotica.
Lima levigata.
Cardiomorpha oblonga.
Actinocrinus triacontadactylus.
Cyathocrinus pinnatus.
Cyathophyllum crenulare.
Lithodendron.
Amplexus coralloides.
Fenestella.

We also observed a nodular structure frequently occurring throughout this limestone; and the texture of the stalactites, dripping from the roofs of these caves, is remarkably clear, hard, and crystalline.

At Shandon and Bayview, the limestone is of a very light colour, and produces tolerably good lime, though not nearly equal to that of Carlow, Kildare, and other parts of Leinster.

At Bayview, we found conglomerate formed of limestone pebbles, of considerable size; the rock also varying much in hardness and texture. We obtained several specimens of remarkably contorted encrinites: from the appearances observable in some of them, they seem as if motion had occurred with unequal sliding parallel to the planes of bedding, causing the once circular and perpendicular, but now elliptical, sections of the encrinite stems to lie in planes inclined to those of bedding at acute angles.

It might be interesting to examine these examples in connexion with

our President's rules for distortion of fossils, published in a former number of our Proceedings.

We again come on the Lower Limestone Shale at Ballynacourty, where the number of encrinites is positively infinite. The rock is simply one mass of encrinites, cemented together by soft shale.

We also found here specimens of the *Pleurorhynchus alæformis*, much compressed. Near Clonea Castle, at the junction of the limestone and shale, we noticed what seemed at first to be dark-coloured rocks, in a small stream which cuts its way to the sea through the fine sand which, to a small extent, covers this part of the coast; but, to our surprise, these turned out to be *turf*, principally formed of debris of pine and oak—forests of a former age; it was in the pine of this submerged turf-bog that Dr. Farran found the *Teredo Norvegica*, an account of which he published some few years since in the Journal of the Natural History Society of Dublin.

On passing Clonea, the shore is strewed with debris of sandstone and shale in boulders, with coarse gravel, those of sandstone conglomerate often very large; and the shale is here covered above the cliffs, with upwards of eighty feet of drift and clay. Presently, we again meet the red, purple, and yellow Sandstones; and at this point data exist for determining the whole thickness of the sandstones of the district,—it being, as it were, epitomized here in one compact wedge, which is interposed between the Carboniferous and Silurian series.

Close to Ballyvoyle Head, above the River Tay, we observed faint marks, similar to those in the Old Red Sandstone, before mentioned, which may have been plant-remains; but they were too indistinct to enable us to form a definite opinion as to the geological horizon in which they occur. It may be mentioned, that beds of sandstone shale and Yellow Sandstone here alternate, and are often of a micaceous character.

We next met rocks which, though apparently Igneous, presented appearances of stratification so decided, that they may possibly partake of Metamorphic character. Close to these, a dyke of greenstone penetrates the Silurian, which here, as well as throughout the whole section, presents a series of synclinal axes, owing, no doubt, to the agency of the uptruding greenstone.

Passing Stradbally at Blind Cove, we determined, by direct observation, the greenstone cliffs to rise perpendicularly to the height of 300 feet out of the sea; and in the Silurian slate following, we observed a considerable amount of chlorite.

Still proceeding eastward in the Silurian, we observed a wedge of compact Silurian, apparently let in so as to form faults on both sides in the face of the cliff, which had evidently been much exposed to disintegrating influences; a vein of the same formation, strangely twisted, of a lighter or whitish-blue colour, appears to have been subsequently introduced, from the fact of the planes of lamination occupying an oblique position.

In a direct line, and parallel to the coast, an elvan dyke here occurs, broken at intervals, containing copper, which, for the first time, is now

met with. We also, in conjunction with the Silurian, found quartz and calcareous spar distinctly crystallized in one block. We may mention, in passing, that the greenstone rocks throughout the district have distinct planes, similar to those of bedding.

At Ballydowane Bay, curious conjunctions and faults occur between the Old Red Sandstone and surrounding greenstone, as will appear by reference to a sketch which we attach.

Between Rinnamoe Head and Bunmahon Head we found a large piece of rock containing galena. We merely mention the fact to call the attention of future geologists in that neighbourhood to the circumstance, as galena has not hitherto been found in the district, at least that we are aware of.

In this locality we obtained good specimens of greenstone porphyry, the crystals being of red felspar; as also specimens of siliceous felspathic light-green porphyry. Nearer to Bonmahon, the Old Red Sandstone again occurs; and the peculiar appearance may be occasionally observed, for which Professor Haughton, in his late paper on Cyclostigmaceæ, has proposed the term tribolith; but this structure is much better developed in the Kiltorkan beds than in those of Waterford.

The devastation which the sea and land springs are making on this coast must be seen to be appreciated. We can easily conceive that, within a very short period (geologically speaking), Ireland stretched far south into the Atlantic Ocean; and that its Old Red Sandstone coast, now swept away, or only evidenced by detached masses, boulders, and shingle, along the shore, once extended, forming an unbroken range, from Helvick Head, in the county of Waterford, by Milford Haven, to the Red Sandstones of Herefordshire.

From Knockmahon, all along the cliffs, to Dunnabrattin Head, the devastating action of the sea is fast antiquating the most recently constructed maps of the coast line,—carrying away, from time to time, large masses of disjointed greenstone and Silurian rock, to mingle with the rolled and rounded debris of the Red Sandstone, which everywhere strew the coast.

We spent five hours, one day, very pleasantly, underground in the Tankardstown copper-mines, through the kindness of the manager, Captain Francis Bennet; and specimens of the various kinds of gangue, ore, and elvan, which occur in them, we have laid on the table for the inspection of the Society.

We obtained very fine specimens of malleable copper, but only near the surface; the sulphide appearing in depth as we descended. In one instance, in the Bonmahon mine, the lode is interrupted by a band of Red Sandstone; there also occur very distinct examples of reversed faults.

In conclusion, we would suggest, that the great disturbing influences observable all through the section described in the present communication, as shown by the numerous synclinal and anticlinal axes, considered in connexion with the distortions of the Carboniferous fossils and the dykes mentioned as occurring in the Silurian district, may have arisen from

pressures along a fixed line of internal and probably igneous action running through Knockmahon, the Wicklow Mines, Isle of Man, Westmoreland, and Kirkcudbright, the active periods of which were successively recurring, some during the Silurian epoch, and coinciding with E. de Beaumonts' second Palæozoic system of disturbances; another of those periods of activity may have been towards the latter end of the deposition of the Old Red Sandstone; while others, again, may have been during the Carboniferous period; and we think that the tribolithic appearance to which we before referred, may also tend to corroborate this theory, as being proof of sliding having taken place under circumstances of severe pressure affecting the mass of the Sandstone strata.

VIII.—On some Additions to the Yellow Sandstone Flora of Donegal. By the Rev. Samuel Haughton, F. R. S., Fellow of Trinity College, and President of the Geological Society of Dublin.

(Plates III., IV., V.)

[Read before the Geological Society of Dublin, December 12, 1860.]

Some weeks ago, Mr. William Harte, Surveyor of the county of Donegal, having discovered some fossil plants at Darney, near Dunkineely, county of Donegal, forwarded them to me for examination. On inspection, I recognised several of them as old friends, and others illustrating new features in the structure of known fossil plants of the Yellow Sandstone Period; while one of them appeared to me so completely novel, as to warrant me in bringing it under the notice of this Society.

This fossil is evidently the cast of the mid-rib and lateral branches of a large leaf, and appears to be exogenous. Professor Harvey, however, considers it may be endogenous, and quotes, in illustration of this view, the leaves of the Aroideæ.

It bears so striking a resemblance to the *Dictyophyllum crassinervium* of Lindley, that I do not hesitate to place it in that genus, and to give it the name *Dictyophyllum Darniense*, from the Yellow Sandstone locality in which it was found.

The other plants found by Mr. Harte bear a striking resemblance to the *Lepidodendron Griffithii*, found at Kiltorcan by Dr. Carte, and described by A. Brongniart. I believe, however, that this species and the so-called Knorrias of the south of Ireland and Germany are identical with the plants which I have elsewhere referred to the genus Cyclostigma.

Another of the plants found by Mr. Harte is a Stigmaria, exhibiting the remarkable peculiarity of a central "core," or axis, which is itself marked with the leaf-scars, to which the term Knorria has been applied.

DESCRIPTION OF THE PLATES.

PLATE III.

Dictyophyllum Darniense.—Cast of the mid-rib and lateral nerves of a large fossil leaf, showing, apparently, exogenous reticulation.

PLATE IV.

Stigmaria.—Showing the lateral rootlets and Cyclostigmatic markings peculiar to the genus, with the minute dot in the centre of each, corresponding to the bundle of woody fibres; also exhibiting the central "core," with its Lepidodendriform, or Knorria-like markings.

PLATE V.

(*a*) Cast of a portion of the leaf or bark of an unknown fossil plant.
(*b*) *Cyclostigma* (*Lepidodendron*) *Griffithii* (A. Brongniart), showing the dichotomous branching and peculiar arrangement of the leaf scars.
(*c*) Another specimen of ditto.

IX.—A NEW PYROGNOSTIC ARRANGEMENT OF THE SIMPLE MINERALS HITHERTO FOUND IN IRELAND. By AQUILLA SMITH, M.D., M.R.I.A.

[Read before the Geological Society of Dublin, June 13, 1860.]

[THE PRESIDENT stated that Dr. Aquilla Smith had entrusted to him his numerous notes on Irish Mineralogy, which in his (the President's) opinion were of the highest interest and value, both in a historical and in a scientific point of view. It was his intention to bring these notes from time to time before the Geological Society, and to add to them such contributions as his own knowledge of Irish minerals enabled him. As a commencement, he introduced to their notice the following tabular classification of Irish Minerals, founded altogether upon their pyrognostic characters. It was quite unnecessary for him to comment on Dr. Smith's known skill in the use of the blowpipe, which he regarded as the most valuable instrument in the possession of the mineralogist. He had himself, under Dr. A. Smith's instructions, attained to some skill in the use of this weapon, and felt much pleasure in bearing his testimony to the value and accuracy of the following classification.]

"The merit of mineralogy seems to me to consist in presenting such *criteria* as may enable us to distinguish minerals in the shortest, easiest, and surest manner."

KIRWAN, 1784.

Class I.—FUSIBLE.

Order I.—COMBUSTIBLE.

Div. I.—Combustible *with* flame.
Div. II.—Combustible *without* flame.

Order II.—Incombustible.

Div. I.—Fuse into a slag or bead.*
- A. *With* exfoliation, intumescence, or effervescence.†
  - *a*. Bead colourless or white.
    1. Anhydrous.
    2. Hydrous.
  - *b*. Bead coloured.
    1. Form a slag or scoria.
    2. Form a perfect bead or globule.
- B. *Without* exfoliation, intumescence, or effervescence.
  - *a*. Bead colourless or white.
    1. Anhydrous.
    2. Hydrous.
  - *b*. Bead-coloured.
    1. Not metallic nor magnetic.
    2. Metallic or magnetic.

Div. II.—Fuse on the edge, but do not form a bead.
- *a*. Fused portion colourless or white.
  1. Anhydrous.
  2. Hydrous.
- *b*. Fused portion coloured or black.
  1. Not magnetic.
  2. Magnetic.

Class II.—INFUSIBLE.

Order I.—Effervesce with Acids or with Borax.

Order II.—Do not effervesce with Acids or with Borax.

Div. I.—Hardness under 6, or yield to the knife.
Div. II.—Hardness above 6, resist the knife.

APPENDIX.

Minerals not arranged.

CLASS I.

Order I.

I. Division.—*Combustible* with *flame*.

1. Sulphur. Pale yellow colour, burns with a blue flame, and suffocating odour.

2. Amber. Yellow, becomes electric by friction with a piece of silk or woollen cloth, and attracts light bodies.

3. Bituminous Wood. Brownish black, burns with a weak flame.

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* The assay should be the size of a common pin's head.

† Decrepitation is not a permanent character, even in specimens of the same species, e. g. fluor spar and sulphate of barytes.

4. Bituminous Coal. Black, burns with a bright flame and much smoke.

II. Division.—*Combustible* without *flame*.

5. Gray Antimony. Heavy, melts first, and emits strong sulphurous odour.
6. Anthracite. Light, colour black, burns slowly.
7. Graphite. Grayish black, soils paper, burns *very slowly*.

Order II.—Incombustible.

I. Division.—*Fuse into a slag or bead.*

A. *With* exfoliation, intumescence, or effervescence.
a. Bead colourless or white:
1. Anhydrous.
8. Prehnite. Pale yellowish green, fuses readily with borax.
9. Scapolite. With borax it fuses with effervescence until the assay is entirely dissolved.
10. Spodumene. Contains lithia, and tinges the flame carmine red, when its proper flux or test is used.
11. Pearlstone. Occurs in globular concretions, and fuses with some difficulty.
2. Hydrous.
12. Selenite. Exfoliates or curls up; yields to the nail.
13. Stilbite. Ditto, ditto.
14. Heulandite. Ditto, ditto, high pearly lustre.
15. Apophyllite. Ditto, ditto, square prisms, or some with four-sided pyramids.
16. Thompsonite. Ditto, ditto, in long radiating prisms.
17. Skolezite. Ditto, ditto, ditto.
18. Chabasie or Levyne. Intumesces much, does *not* gelatinize in warm nitric acid.
19. Laumonite. Gelatinizes, in nitric acid.
20. Mesole. Ditto, ditto, in globules of a radiated structure.
21. Chalilite. Ditto, ditto, amorphous, colour reddish or yellow.
22. Killinite. Found only in granite at Killiney, county of Dublin.

Note.—Nos. 13 to 21, inclusive, are found only in trap rocks, and chiefly in the north of Ireland.

b. Bead coloured.
1. Form a slag or scoria.
23. Epidote or Zoisite. Baikalite.
24. Dark-green Tourmaline.
2. Form a smooth bead.
25. Idocrase. Hardness = 6·0.
26. Talc. Soft, in thin laminæ, not elastic.
27. Mountain Cork. Amorphous, yields to the nail.

Order II.

I. Division.—*Fuse into a slag or bead.*

B. *Without* exfoliation, intumescence, or effervescence.

a. Bead colourless or white.

1. Anhydrous.

28. Fluate of Lime. Purple colour, corrodes glass when heated with sulphuric acid, crystals cubic.
29. Sulphate of Barytes. Heavy.
30. Sulphate of Strontian.
31. Phosphate of Lead. Forms a polygonal bead, and yields lead when fused with carbonate of soda.

2. Hydrous.

32. Gypsum or Vulpenite. Soft.
33. Erinite. Soft.
34. Hydrolite.
35. Philipsite.
36. Harmatome. In quadrangular prisms, forming macles.
37. Natrolite or Lehuntite. Fuses slowly with borax.
38. Mesotype.
39. Antrimolite.
40. Harringtonite.
41. Analcime.

Note.—Nos. 32 to 41, inclusive, are found in the trap districts, chiefly in the north of Ireland. Harmatome occurs on granite in the county of Wicklow.

b. Bead coloured.

1. Not metallic nor magnetic.

42. Essonite. Amorphous, bead translucent, greenish.
43. Garnet. Crystallized, bead black.
44. Chlorite. Green, soft, granular, amorphous.
45. Kirwanite.
46. Actinolite.
47. Hornblende.
48. Augite.
49. Lievrite.
50. Pitchstone.

2. Metallic or magnetic.

51. Gold.
52. Copper. A malleable bead.
53. Red Oxide of Copper, Tile Ore. Ditto.
54. Black Oxide of Copper. Ditto.
55. Green Carbonate. Effervesces with acid.
56. Blue Carbonate. Ditto.
57. Brittle Silver Ore.

58. Galena.
59. Carbonate of Lead. Effervesces with acid.

The Nos. 51 to 59 yield a malleable bead.

60. Vitreous Copper.
61. Purple Copper.
62. Fahl Ore.
63. Copper Pyrites.
64. Sulphuret of Nickel. In delicate acicular crystals.
65. Grey Cobalt. Colours borax deep amethyst colour.
66. Red Cobalt. Ditto.
67. Wolfram.

ORDER II.

II. Division.—*Fuse on the edge, but do not form a bead.*

a. Fused portion colourless or white.

1. Anhydrous.

68. Asbestus. Fibrous.
69. Amianthus. Ditto.
70. Tremolite. Ditto.
71. Pinite. Six-sided prisms, hardness = 2·5.
72. Apatite. Ditto, hardness = 5·0.
73. Sahlite.
74. Felspar. Hardness = 6·0.
75. Adularia. Ditto.
76. Albite. Ditto.
77. Moonstone. Ditto.
78. Labradorite. Ditto.
79. Iolite.
80. Indicolite. Dark blue, in long prisms.
81. Beryl. In six-sided prisms.

2. Hydrous.

82. Plinthite.
83. Steatite.
84. Serpentine.
85. Schillerspar.
86. Chiastolite.

b. Fused portion, coloured or black.

1. Not magnetic before or after roasting.

87. Mica. Soft in elastic laminæ.
88. Red Manganese. Colours borax deep purple.
89. Calamine. Effervesces with borax.
90. Blende. In a strong heat its edges round off, but do not fuse; it is yellow while warm.
91. Sphene.

2. Magnetic before or after roasting.

92. Carbonate of Iron. Effervesces with borax.
93. Red Hematite. Streak red.

94. Brown Hematite. Streak yellowish brown.
95. Specular Iron, Micaceous. Streak red, transmits a red colour.
96. Magnetic Iron-stone. Magnetic before roasting.
Magnetic Iron-sand. Ditto.
97. Oxydulous Iron. Ditto.
98. Arsenical Iron. Emits smell of arsenic.
99. Iron Pyrites. Emits smell of sulphur.
100. Clay Iron-stone.
101. Meadow Iron Ore.
106. Nigrine.
107. Phosphate of Iron.

Class II.—INFUSIBLE.

Order I.—Effervesce with Acids or with Borax.

108. Calcareous Spar.
Schiefer Spar.
Rock Milk.
Chalk.
Swinestone.
Dolomite.
109. Arragonite. Contains Strontian.
110. Pearl Spar.
111. Carbonate of Magnesia.
112. Carbonate of Strontian. Colours the flame carmine red.
113. Carbonate of Zinc.

Order II.—Do not effervesce with Acids or Borax.

Div. I.—*Hardness under* 6·0, *or yield to the knife.*

114. Nacrite,	,,	= 2·25.	In small scales.
115. Lithomarge,	,,	2·5.	Amorphous.
116. Rhodalite,	,,	2·0.	
117. Wavellite,	,,	3·5.	In radiated globules.
118. Earthy manganese,	,,	1·0.	Colours borax deep purple.
119. Compact.			Ditto.
120. Grey.			Ditto.

Div. II.—*Hardness above* 6·0, *or resist the knife.*

121. Tinstone.
122. Chrome iron. Colours borax green of rich colour.
123. Rutile.
124. Grenatite.
125. Andalusite.
126. Quartz, rock-crystal, &c.
127. Olivine.
128. Topaz.
129. Corundum.

APPENDIX.

Containing minerals mentioned in the Catalogue of Giesecke, &c., but not included in the foregoing arrangement:—

No. in Giesecke's Catalogue,	76. Porcelain clay.
„	77. Pipe do.
„	78. Slate do.
„	79. Clay-stone.
„	80. Tripoli.
„	81. Alumstone.
„	82. Bituminous slate.
„	83. Drawing slate.
„	84. Whet slate.
„	85. Clay slate.
„	86. Alum slate.
„	89. Potstone.
„	99. Wacke.
„	100. Iron clay.
„	101. Green earth.
„	103. Bole.
„	104. Cimolite.
„	107. Nephrite.
„	158. Slaggy mineral pitch.
„	159. Bog tallow.
„	222. Orthite.

GENERAL LAWS OF THE EFFECT OF HEAT, FLUXES, ETC., ON THE EARTHY MINERALS. DEDUCED FROM EXPERIMENTS BY A. SMITH.

1st Class.—Compounds of *Silex*, *Alumina*, Iron, Water, &c.

In the forceps most of them are infusible, those containing a large portion of iron glaze or fuse on the edge, in proportion to the quantity of iron they contain; with borax, they are almost insoluble. The anhydrous species are hard: those which contain water in chemical combination are rather soft. They all become blue when heated with solution of nitrate of cobalt, except such as contain iron.

2nd Class.—Compounds of *Silex*, *Alumina*, *Alkalies*, Iron, Water, &c.

In the forceps they all fuse quietly (?) on the edge: some form a bead. With borax, most of them dissolve slowly; a few more readily. The anhydrous species are harder than the hydrous: some of the latter gelatinize in nitric acid.

3rd Class.—Compounds of *Silex*, *Alumina*, *Lime*, Iron, Water, &c.

In the forceps all fuse, most of them with intumescence, and form a bead readily. With borax, all dissolve; many speedily, some slowly. Hardness of the anhydrous species generally from 6 to 7; of the hydrous, from 3 to 5.

4th Class.—Compounds of *Silex*, *Alumina*, *Magnesia*, Iron, Water, &c.

In the forceps all fuse on the edge; some form a bead. With borax, all dissolve; some speedily, some slowly.

5th Class.—Compounds of *Lime* and *Acids*.

The carbonates are infusible; the others are fusible. With borax, all dissolve; some speedily, the carbonates with effervescence.

6th Class.—Compounds of *Silex*, *Magnesia*, Iron, Water, &c.

Infusible, or fuse slowly on the edge. With borax, dissolve very slowly.

7th Class.—Compounds of *Silex*, *Magnesia*, and *Lime*.

All fusible; some readily, some on the edge. All soluble in borax; some readily, some slowly.

8th Class.—Compounds of *Barytes*, *Strontian*, and *Acids*.

X.—The Localities of the Irish Carboniferous Fossils, arranged according to the Stratigraphical Subdivisions of the Carboniferous System adopted in the Geological Map of Ireland, with the Irish Mining Localities as appended to the Synoptical Table of Fossils, engraved on the Margin of that Map, and as originally compiled for the Use of the General Valuation of Ireland.

By Sir Richard Griffith, Bart., LL.D., F.G.S., &c., &c.

[Read before the Geological Society of Dublin, March 10, 1860.]

The synopsis of the fossils collected by me from the Carboniferous Limestone of Ireland, as at present contained in my cabinet, was originally intended to form a portion of an extended work, explanatory of the details of my Geological Map; but duties of a public nature having hitherto prevented the execution of my design, I am induced to submit to the members of the Geological Society of Dublin, the authentic Tables, originally prepared according to my views of the natural subdivisions of the Carboniferous Limestone system of Ireland, and engraved, in a condensed form, in the years 1853–4–5, on the margin of the map before mentioned.

The want of a general geological description has, however, in some measure been supplied by the publication, in the "Journal of the Geological Society of Dublin," of numerous papers which, on various occasions, became necessary to explain or defend the views of the Carboniferous System as developed in Ireland which I have adopted; and I may mention, that, with a view to a more extended circulation of the "Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland," I intend to offer to the public the copies of that work now remaining in my possession, with an adaptation of the following Tables appended, by which I hope to render the work more generally useful than it has hitherto been.

In my original examinations of the country, I found that its local peculiarities naturally suggested other stratigraphical subdivisions and wider generalizations than were supplied by any arrangements existing at the time, and which were principally applicable to England; and in this view, while adhering as much as possible to the systems of preceding geologists, I did not scruple to make such modifications and additions as appeared to me necessary to exhibit clearly the true stratigraphical succession presented by the rocks of which our Carboniferous Limestone system is composed; and this object was not finally completed until I had thoroughly examined, in every part of Ireland, the succession of these strata as they occurred between their immediate base, resting on the Old Red Sandstone, and their termination, at the commencement of the Coal series; and by this means I have been enabled to engraft several additional members on the Carboniferous Limestone system, which are altogether wanting, or so slightly developed, in England and Scotland, as nearly to pass unnoticed, or to be considered merely as accidental variations.

I have so frequently given descriptions, more or less detailed, in different papers and publications, relative to the several groups of which the Irish series consists, that it is almost superfluous to repeat them in this place; but to save troublesome references, I shall briefly recapitulate a few of the leading facts. I should premise that the several subdivisions in the system which I have introduced are based chiefly on lithological character and stratigraphical position, aided by fossiliferous evidence; and in regard to any group of the series which may appear to some geologists to require further elucidation, I expect to be enabled, on some future occasion, to submit the result of my continued researches to the Society.

The Carboniferous system in Ireland is separable into three leading groups, each distinguished by the difference of their lithological character and composition, as well as by the persistence of their relative positions,—this latter being strikingly exhibited in numerous sections made by me in various parts of the country, some of which I have had engraved on the margin of my Geological Map; and taking into account the agreement which the contained fossils maintain with similarity of lithological character, I am of opinion that the geological divisions adopted by me are entitled to attentive consideration.

Considering the comparatively early period at which Professor M'Coy was employed in examining the fossils described in the Synopsis above referred to, it was only to be expected that certain modifications of his views would arise as discovery advanced; but these have hitherto been chiefly limited to the genera of Brachiopoda, which have been studied with so much ability and success by Mr. Thomas Davidson, to whose works I beg to refer on the subject; but the synopsis will continue an indispensable reference for the fossils described therein for the first time, which amount to upwards of 450.

The several members of the Carboniferous system were originally proposed by me in the Report of the Irish Railway Commissioners, pre-

sented to Parliament in the year 1838; and they were further developed and matured at various meetings of the British Association, especially at that held at Manchester, in the year 1842,—ultimately assuming the complete form of which I beg now to offer the following brief description:—

Commencing at the base, the first, or Yellow Sandstone group, which rests conformably on the subjacent and hitherto non-fossiliferous Old Red Sandstone, is divisible into two members—namely, Yellow Sandstone proper, and Carboniferous Slate—the latter of which frequently assumes the character of Lower Limestone Shale, the whole group being intimately connected with the next overlying series. The first-named member consists of yellowish, white, and variously-coloured sandstones and conglomerates, having occasional interstratifications of Arenaceous Limestone and Arenaceous Shale; while the last, in ascending order, is composed of shales or argillaceous strata, occasionally alternating with limestone, in the northern and midland districts of Ireland, but which become towards the southern shore of the counties of Cork, Waterford, and Kerry, a true Carboniferous roofing-slate, having planes of cleavage.

Amongst other fossils, characteristic respectively of either subdivision, the fish remains, as *Holoptychius* of the Yellow Sandstone shales of the valley of Ballinascreen, in the county of Londonderry, and the *Posidonia* of the fissile Carboniferous Slate of the Old Head of Kinsale, in the county of Cork, may be specially mentioned.

Carboniferous plants of a remarkable character (some of which I have enumerated in the Tables engraved on the margin of my Geological Map) are found to occur at the base of this group, such as the *Sphenopteris Hibernica* and *Cyclostigma* of Kiltorcan, Tallow Bridge, &c., the large fossil-tree (*Stigmaria*), obtained by me, at Mac Swyne's Bay, in Donegal, which also occurs at the north coast of Mayo, with marine fossils, exogenous wood, &c., identifying both localities with certain German beds at Landeshut and Haynichen, many specimens of which are in the possession of Professor Haughton, besides Sigillaria, Lepidodendron, &c.; and it is probable that these descend much farther down into the Old Red Sandstone than has hitherto been supposed; upon the evidence of which, as I have elsewhere observed, it is possible that the Irish Devonian series may ultimately be included as a member of the overlying and conformable Carboniferous Series. It was in the Yellow Sandstone group, in the same beds containing the Stigmaria of Mac Swyne's Bay, that Mr. Harte, County Surveyor of Donegal, lately discovered the gigantic cabbage-like leaf, similar to the *Dictyophyllum crassinervium* of the New Red Sandstone, which we may expect to have fully described by our President on a future occasion.

Still ascending, we find, in conformable succession, the Carboniferous Limestone series, or second group of the system, which clearly exhibits a triple arrangement, being divisible into a lower and upper bluish-gray, subcrystalline, and highly fossiliferous limestone, which are separable from each other by the interposition of beds of dark-gray shale, occasionally alternating with dark-gray, impure, argillo-siliceous limestone, to which, as the middle member of the Carboniferous Limestone group, I

have applied the provincial term "Calp," originally adopted by the late Mr. Kirwan, from an expression locally used for rocks of this mineral character, which in various parts of Ireland, especially in its midland and eastern district, from Edgeworthstown to Dublin, occupy a large superficial area. The Calp series, in certain districts of the North of Ireland, consist of an upper and lower shale, having a fugitive bed of yellowish-gray sandstone intercalated, which latter disappears as we proceed to the south and east, where the Calp strata, though of moderate thickness, forms, from its superficial extent, a geological feature of much importance in an agricultural point of view, as affording valuable and improving pastures, remarkable for the production of cocksfoot and other superior feeding grasses.

The great Carboniferous Limestone plain of Ireland, which is highly fossiliferous, occupies nearly two-thirds of the country; and the soils resulting from its disintegration, though variable in quality, are of great natural fertility, becoming unusually productive upon their intermixture with granitic and other rocks in a state of decomposition. Many of the fossils which occur in the limestone group are common to the other subdivisions of the system; but distinct mineral conditions will be found to be accompanied by a corresponding peculiarity of prevailing fossils.

Resting conformably upon the Upper Carboniferous Limestone, we arrive at the strata of the Coal series, which, forming the third group of the system as arranged by me, is again divisible from its base into a millstone grit, a lower, and an upper Coal series.

The millstone-grit formation consists of an upper and lower yellowish-white sandstone, separable by the interstratification of beds of black shale, and occasionally limestone, which contain nearly every class of the ordinary Carboniferous fossils—these, however, being generally much inferior in size to those occurring in the lower members of the system.

In common with the sandstones, impressions of coal-plants also occur in these shales, and they sometimes accompany the marine remains, amongst which latter it is remarkable that *Posidonia* and *Goniatites striolatus* extend from the Carboniferous slate, at the base, to the millstone grit, at the top of the series.

The upper and lower Coal formations are characterized, as in England, by the usual plants; but the Molluscan remains, which hitherto seem to consist of only one species of fresh-water bivalve, like *Modiola* with a portion of a Trilobite, appear to have a very local existence in our coal-fields, which, notwithstanding the unusual development of the Carboniferous system in Ireland, do not justify any promise in regard to their comparative commercial value,—the bituminous coal of the country being limited to isolated districts of small extent in the North of Ireland, which have nearly, if not altogether, been worked out; and the coal-fields of the southern counties supply only anthracite. In an agricultural point of view, lands of superior fertility are often found to occur along the boundaries of junctions between the Upper Carboniferous Limestone and the shales of the Coal series, notwithstanding the sterility usually existing in the interior districts of the latter.

I have only to hope that the foregoing brief description will be sufficient to exhibit the principles by which I have been guided in the execution of an enterprise undertaken in an unknown field, the difficulties of which, it will be admitted, could only have been overcome by the adoption of a system suited to the peculiarities of the country.

I have thought it desirable to add an appendix of the Irish mining localities, compiled from the Geological Map for the use of the General Valuation of Ireland; but I have not ventured to offer any opinion respecting their productiveness in a commercial point of view, as the development of the value of mining property is rather the concern of individual enterprise.

ABSTRACT OF CARBONIFEROUS LOCALITIES, WITH THEIR POST-TOWNS, DIVIDED INTO COUNTIES.

ANTRIM.

Saltpans, Ballycastle.
Tornaroan, Ballycastle.

ARMAGH.

Annahugh, Armagh.
Ballygasey, Loughgall.
Cabragh, Armagh.
Downs, Armagh.
Drummanbeg, Armagh.
Drummanmore, Armagh.
Enagh, Tynan.
Farmacaffy, Armagh; or Red Barn, Armagh.
Fellow's Hall, Tynan; or College Hall.
Kilmore, Armagh; or Eglish.
Lisadian, Armagh.
New Road, Armagh.
Red Barn, Armagh, or Farmacaffy.
Salter's Grange.
Tullyard, Armagh.
Tullyree, Armagh.
Tynan.

CAVAN.

Aghaboy, Swanlinbar; or Pollnagollum, Swanlinbar.
Alteen, Stream, Armagh.
Ballyconnell, Ballyconnell.
Clonkeiffy, Virginia.
Countenan, Stradone.
Cuilcagh Bridge, Swanlinbar.
Gibber Bridge, Kingscourt.
Golin, Cavan.
Kilmore, Cavan.
Killeshandra, Cavan.
Laragh, Stradone.
Pollnagollum, Swanlinbar, or Aghaboy.
Townparks, Killeshandra.
Swanlinbar.
Swellan, Cavan.
Virginia.

CARLOW.

Bannaghagole, Leighlin Bridge.
Bilboa Colliery, Carlow.
Old Leighlin, Leighlin Bridge; and Raheen, Leighlin Bridge.
Raheendoran, Carlow.

CLARE.

Belfield, Milltown Malbay.
Cahir Rush, Milltown Malbay.
Cloonlara, Clare; Meelick Chapel, Clare; Coolin, Corofin.
Derrybryan, Clare; and Inchiquin, Corofin.
Doon, Mount Phelim, Ennistymon.
Kilkee, Milltown Malbay.
Kilmacduagh, Gort; at Boston Chapel.
Meelick Chapel, Clare, or Cloonlara.
Scarriff, Killaloe.

CORK.

Annagh, Charleville.
Arraglin Bridge, Kilworth, or Fermoy.
Ballinhassig, Cork.
Banteer, Kanturk.
Bantyre, Cork.
Ballybeg, Buttevant.
Ballygarvan, Cork.
Ballymakean, Kinsale.
Blackball Head, Kenmare.
Blackrock, Cork.
Carrigaline, Cork.
Castlecree, Doneraile.
Castlerichard, Middleton.
Castlesaffron.
Castletownsend, Cork.
Cove, Cork.
Derrylief, Cork.
Doneraile, Doneraile.
Dromagh Colliery, Kanturk.
Dunally, Cork.
Dunboy Point, Castletown; Bearhaven, E. of Blackball Head.
Fortwilliam, Doneraile.
Garryvessoge, Kanturk; and Glengariff.
Gurteen Colliery, Banteer.
Gurteenroe, Bantry.
Killingley, Ballea.
Kingwilliamstown, Castleisland.
Kilkatern, Berehaven.
Ledwithstown.
Lispatrick, Cork; Old Head of Kinsale.
Little Island, Cork.
Middleton, Cork.
Nohaval, Kinsale.
Reendonoughan, Bantry.
Rinniskiddy, Cork.
Shanbally, Carrigaline.
Streamhill, Doneraile.
Tankardstown, Kildorrery.
Town of Bantry.

DONEGAL.

Abbeybay, or Abbeylands, Ballyshannon.
Aighan Bridge, Dunkineely.
Ardloughill, Ballyshannon.
Ballybodonnell, Dunkineely.
Bruckless, Dunkineely.
Bundoran, Bundoran, or Ballyshannon; Donegal Bay, West Coast.
Doorin, Donegal.
Doorin Point.
Drummeenanagh, or Thrushbank.
Drummagroagh, Ballyshannon.
Dunkineely.
Esk Lough, Donegal.
Finner, Bundoran.
Greaghs, Ballintra, or Donegal.
Inver, Donegal.
Kilcar.
Killaghtee, Dunkineely, or Donegal.
Laghy, Donegal.
Lisnapaste, Ballintra.
Mac Swyne's Bay, Dunkineely.
Rahan's Bay, Dunkineely.
St. John's Point, Dunkineely.
Spierstown, Donegal.
Stridagh Point, Donegal.
Thrushbank, or Drummeenanagh.
Tinnycahill, Donegal.

DOWN.

Castle Espie, Comber.
Cultra, Hollywood.

DUBLIN.

Baldongan, Skerries.
Ballykea, Skerries, or Drumlattery, Skerries.
Clontarf, Dublin.
Courtlough, Balbriggan.
Curkeen, Skerries, or Rush.
Drumlattery, Skerries, or Ballykea.
Flemingstown, Balbriggan.
Howth, Dublin.
Lane, Skerries.
Loughshinny, Rush.
Malahide, Malahide.
Milverton, Skerries.
Naul, Balbriggan.
Oldtown, Dublin.
Rush, Rush.
St. Doolough's, Dublin.
Salmon, Man of War, Balbriggan.
Poulscadden, Howth.
Raheny, Dublin.
Rathbale, Swords.

FERMANAGH.

Ardatrave, Kesh.
Agharainey, Kesh.
Ballylucas, Lisbellaw.
Bannaghbeg, Kesh.
Bannagh River, Kesh.
Bellanaleck, Enniskillen.
Belmore Mountain, Enniskillen.
Boa Island, Kesh; Lough Erne.
Boherroy, Churchill.
Bohevny, Enniskillen.
Bunnaninver, Kesh, or Archdall.
Callaghan, Belleek.
Carn, Ederny.
Carrigolagh, Belleek.
Carrickoughter, Kesh.
Carrickreagh, Enniskillen.
Carrowtremal, Enniskillen.
Castle Archdall.
Churchill, Vicinity of.
Clareview, Kesh, or Lisnarick.
Cleenishgarve, Enniskillen.
Corlave Bridge, Kesh.
Cornacarrow, Enniskillen.
Cornagrade, Enniskillen.
Corrick, Drumieran; Lough Leitrim.
Crevenish Island.
Curraghmore, Pettigo.
Deerpark, Ederny.
Derrygonnelly.
Derrynacapple, Kesh.
Derryvullan, Enniskillen.
Drum, Ederny.
Drumbrick, Ederny.
Drumcurren, Kesh.
Drumgowna, Kesh.
Drumieran, Ederny.
Drumkeeran, Ederny.
Drumreask, Churchill.
Erne Lough, Fermanagh.
Ederny.
Glassdrumman.
Gubbaroe, Kesh.
Kesh, Fermanagh, or Tullanaguiggy.
Kilcar, Belturbet.
Knockninny, Enniskillen.
Leam, Tempo; Moneyburn River.
Meenmossoge, Ederny.
Mullans, Boa Island, Kesh.
Oughterdrum, Belleek.
Poulafooca, Churchill, or Shean.
Scolban Lough, Belleek.
Shean, Churchill, E. of Belleek; or Poulafooca.
Ring, Enniskillen.
Tullanaguiggy, Fermanagh, or Kesh.

GALWAY.

Athenry, and between it and Tuam.
Aughliham.
Ballinfoyle.
Caheratrim, Loughrea.
Cappamoyle, Athenry.
Carrowntobber, Athenry.
Cong.
Cregganore, Gort, E. of Castleboy, or Toberellathan, and Derrybrian Mountains.
Portumna, Galway.
Toberellathan, or Cregganore.
Woodford, Loughrea.

KERRY.

Ballymacelligut, Tralee.
Brickeen Bridge, Killarney, and Brickeen Island.
Castleisland, Castleisland.
Castleogary, Tralee.
Collarus, Kenmare; Ardgroom Harbour.
Currens, Tralee, or Castleisland.
Kenmare.
Loughnacree, Kenmare; Kilmichaelogue.
Muckruss, Killarney.
Mullaun, Ballybunnion.
New Canal, Tralee.
Roughty Bridge, Kenmare.

KILDARE.

Ardclogh, Rathcoole, or Kildare.
Ardpodien, Kildare.
Boston, Rathangan.
Castledermot.
Millicent, Clane.

KILKENNY.

Coolaghy.
Firoda, Castlecomer.
Kiltorcan, Ballyhale.
Skehana, Castlecomer.

KING'S COUNTY.

Ballard.
Banagher.

LEITRIM.

Aghakilfaun, Mohill.
Aghamore, Bundoran; or Ballintrillick, Bundoran.
Ballinafad, Boyle.
Ballintrillick, Bundoran, or Aghamore.
Benbo, Manorhamilton, or Morera.
Black Lion, Enniskillen.
Bleankillew, N. of Drumod, Shannon Shore, and Cairnclonhugh Mountains, middle district.
Braulieve Mountain, Black Lion.
Cavan, Aghamore.
Corry, Drumkeeran.
Derreens, Drumkeeran.
Drumard.
Drumconny, Cloone.
Drumod, Mohill.
Fearnaght Lough Riv., Mohill.
Loughallen, Carrick-on-Shannon.
Manorhamilton, Manorhamilton.
Mohill, or Ussaun.
Morera, Manorhamilton.
Trean, Lurgan; Bar. of Mohill.
Tullyoran, Mohill.
Ussaun, or Mohill.

LIMERICK.

Chicken Hill, Kilmallock.
Foynes, Askeaton.
Kilmallock, Limerick.
Moymore, Tulla.

LONDONDERRY.

Ballynure, Maghera.
Banada, Draperstown, at Bar. Boundary, or Moneyneany.
Corick, Draperstown, or Corick Riv., or Whitewater, Cloughfin.
Cullion, Draperstown.
Desertmartin.
Dromard, Draperstown.
Fallagloon, Maghera.
Forge Bridge on Drumconready.
Moneyneany, or Banada, Draperstown.
Mormeal, Draperstown.
Moyheeland, Maghera, or Draperstown.
Slievegallion, Magherafelt.
White River, Cloughfin, Draperstown, or Corick.

LONGFORD.

Ballymahon.
Carrickboy, Longford.
Carrickduff, Granard.
Cornadowagh.
Granard, Granard.
Kilcommock, Longford.
Monaduff, Drumlish.
Mullawornia, Ballymahon.
Rathcline, Lanesborough.
Shrule, Ballymahon.
Tirlecken, Shrule.

LOUTH.

Carlingford, Carlingford, E. of Dromore.
Kilcurry, Dundalk.
Knockagh, Dundalk.
Millgrange.

MAYO.

Ballina.
Ballinglen, Ballycastle.
Ballycastle, Mayo.
Bunatrahir, Killala.
Crosspatrick, Killala.
Doonfeeny, Killala.
Kilbride, Ballycastle.
Kilcummin, Killala, or Lackan Bay.
Kilglass, E. of Killala Bay, North of Ballina.
Killala.
Killogunra, Killala.
Killybrone, Killala.
Larganmore, Bangor, or Crossmolina.
Moyne Shore, Killala.
Mullaghfarry, Killala.
Mweelbawn.
Swineford.
Townplots, Killala.
Westport.

MEATH.

Altmush, Nobber.
Ardagh, Drumcondra.
Ballyhoe Lake, Drumcondra.
Balsitric, Nobber.
Castletown, Trim.
Churchtown, Nobber.
Clonalvy, Balbriggan, or Flemingstown.
Cregg, Nobber.
Cruicetown, Nobber.
Cusackstown.
Drogheda.
Flemingstown, Balbriggan, or Clonalvy.
Gibstown.
Horath, Moynalty.
Laracor, Trim.
Mullaghfin, Duleek.
Paget Priory, Maynooth; a local name.
Rathgillen, Nobber.
Slane.
Walterstown, Skreen, or Navan.

MONAGHAN.

Clonturk, Carrickmacross.
Dundonagh.
Killyrean Upper, Emyvale.
Killyvilly Wood.
Lattinalbany, Carrickmacross.
Leek, Monaghan.
Monaghan.
Mullaghboy, Monaghan.
Mullaliss, Monaghan.
Mullylusty, Carrickmacross.
Tonyclida, Carrickmacross.
Tonyshanderry, Emyvale.

QUEEN'S COUNTY.

Aghafin, Castletown.
Burris, Maryborough.
Cloghan, Maryborough; a local name.
Mountrath.
Rathaspick.
Ringstown.
Roundwood.
Tinnekill, Mountmellick.

ROSCOMMON.

Aghabehy, Keadue.
Arigna, Keadue.
Ballinafad, Boyle.
Ballyglass, Strokestown.
Cahernanalt, Keadue.
Cartronaglogh, Keadue.
Cleen, Roscommon.
Crosshill, Keadue.
Derreennavoggy, Keadue.
Drum, Ballinasloe.
Drumdoe, Boyle.
Grangemore, Roscommon or Boyle.
Killukin, Carrick-on-Shannon.
Kiltullagh, Castlereagh.
Lackan, Athleague.
Lisardrea, Boyle.
Moore, Ballinasloe.
Oran, Roscommon.
Rathmoyle House, Frenchpark.
Roscommon.
Strokestown, Roscommon.
Termon, Boyle.
Toberory, Tulsk.

SLIGO.

Barnacoghill.
Ballymeeny, Easky.
Ballinafad.
Bunowna, Easky; Easky, Sligo.
Carnly, Sligo.
Carrowmably, Easky.
Carrowmacrory, Tobercurry, Easky, or Templeboy.
Carrowmore, Ballycastle, or Tobercurry.
Carrownsteelagh.
Cashelboy, or Easky.
Culleenamore, Knockanarea.
Culleenaduff, Knockanarea.
Easky, Sligo. See Bunowna and Cashelboy.
Kilglass.
Killeenduff, Easky.
Knockanarea.
Lavally, Ballymote.
Magheramore, Tobercurry.
Streedagh, Sligo.
Templeboy Par.
Tobercurry.

TIPPERARY.

Ballyporeen.
Carrigahorrig, Portumna.
Knocklofty.
Listowel, Thurles.
Nenagh.
New Birmingham, Killenaule.
Newcastle, Clogheen.

TYRONE.

Aghintain, Clogher.
Aghnaglogh, Clogher.
Annagher Colliery, Coal Island.
Annaghilla, Ballygawley.
Ballymacan, Clogher.
Benburb, Caledon.
Cavansallagh, Drumquin.
Claraghmore, Drumquin.
Clare, Cookstown.
Cookstown, Tyrone.
Callaghan, Belleek.
Derryloran.
Donaghrisk, Cookstown.
Dromore, Omagh.
Drumowen, Drumquin.
Drumreagh Etra, Dungannon.
Drumscraw, Drumquin.
Edenacrannon, Dungannon.
Edenassop, Castlederg.
Fasglassagh, Ballygawley.
Fivemiletown, Tyrone, or Rahoran.
Kildress, Cookstown.
Killycloghy, Lisbellaw or Clogher.
Killymeal, Dungannon.
Knockonny, Ballygawley.
Lackagh, Drumquin.
Lismore, Aughnacloy.
Magherenny, Drumquin.
Meenacarrighy, Drumquin.
Mullaghtinny, Clogher.
Mulnahunch, Dungannon.
Prughlish, Drumquin.
Rahoran, Fivemiletown, or Fivemiletown, Tyrone.
Roughan, Dungannon.
Scraghy, Castlederg.
Tymore Todd, Augher.
Tumpher, Dungannon, Stewardstown.

WATERFORD.

Ardoginna, or Ardoe, Youghal, Ardmore.
Balinacourty, Dungarvan.
Ballyduff, Dungarvan.
Ballyvoil Bridge, Dungarvan, and Camphire, Vale of the Bride.
Clonea, Dungarvan.
Curragh, Ardmore.
Glandine, N. of Dungarvan, and Janeville, Vale of the Bride.
Kilnamack, Clonmel.
Lismore, Waterford.
Parkdotia, Waterford.
Tallow Bridge, Waterford.
Whiting Bay, Youghal.

WESTMEATH.

Baskin, Ballymore, Athlone.

WEXFORD.

Hook Head, Fethard, E. side Waterford Harbour.
Kylenamelly, Enniscorthy.
Lumsdin's Bay, Fethard.
Woarwoy Bay, Fethard.

THE CARBONIFEROUS FISH LOCALITIES.

Ballinglen, Ballycastle, Mayo.
Ballygasey, Loughgall, Armagh.
Ballynure, Maghera, Londonderry.
College Hall (or Fellow's), Tynan, Armagh.
Cookstown, Tyrone, Tyrone.
Cultra, Hollywood, Down.
Drummanbeg, Armagh, Armagh.
Enagh, Tynan, Armagh.
Fallagloon, Maghera, Londonderry.
Finner, Bundoran, Donegal.
Hook Head, Fethard, Wexford.
Kilcummin, Lackan Bay, Mayo.
Lumsdin's Bay, Fethard, Wexford.
Malahide, Dublin, Dublin.
Millicent, Clane, Kildare.
Monaduff, Drumlish, Longford.
Mormeal, Draperstown, Londonderry.
Moyheeland, Draperstown, Londonderry.
Poulscadden, Howth, Dublin.
Red Barn, Armagh, or Farmacaffy, Armagh.
River Bannagh, Kesh, Fermanagh.

THE LOWER CARBONIFEROUS PLANT LOCALITIES.

Aighan Bridge, Dunkineely, Donegal.
Ardmore, Waterford.
Ballygarvan, Cork, Cork.
Ballyvoil Head, Dungarvan, Waterford.
Bannagh River, Kesh, Fermanagh.
Blackball Head, Kenmare, Cork.
Bleankillew, N. of Drumod, Leitrim.
Brickeen Island, Killarney, Kerry.
Bruckless, Dunkineely, Donegal.
Bunatrahir, Killala, Mayo.
Bundoran, Ballyshannon, Donegal.
Camphire, Vale of the Bride, Waterford.
Carrick, Draperstown, Londonderry.
Carrowcor, Ballycastle, Mayo.
Clontarf, Dublin, Dublin.
Collarus, Kenmare, Kerry.
Cultra, Hollywood, Down.
Darney, Dunkineely, Donegal.
Dromard, Draperstown, Londonderry.
Drumconny, Cloone, Fermanagh.
Drummanmore, Armagh, Armagh.
Fallagloon, Maghera, Londonderry.
Garryvessoge, Kanturk, Cork.
Glandine, N. of Dungarvan, Waterford.
Glenbehy, Ballycastle, Mayo.
Golin, Cavan, Cavan.
Janeville, Vale of the Bride, Waterford.
Jerpoint Abbey, Thomastown, Kilkenny.
Kilcummin, Lackan Bay, Mayo.
Kilkatern, Bear Haven, Waterford.
Kiltorcan, Ballyhale, Kilkenny.
Larganmore, Bangor, Mayo.
Lismore, Waterford, Waterford.
Lumsdin's Bay, Fethard, Wexford.
Mac Swyne's Bay, Dunkineely, Donegal.
Monaduff, Drumlish, Longford.
Naul, Dublin, Dublin.
Raheen, Leighlin Bridge, Carlow.
Roughty Bridge, Kenmare, Kerry.
Rush, Dublin.
Tallow Bridge, Waterford, Waterford.
Termon, Castlereagh, Roscommon.
Woarwoy Bay, Fethard, Wexford.

CATALOGUE OF THE IRISH CARBONIFEROUS FOSSILS, &c.

SECTION I.

The first Portion of the Carboniferous Series, or Yellow Sandstone group, consists of four subdivisions, namely, Yellow Sandstone proper, Carboniferous Slate or Lower Limestone Shale, Arenaceous Shale, and Arenaceous Limestone.*

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
MOLLUSCA.			
CEPHALOPODA.			
ORTHOCERATIDÆ.			
Orthoceras	attenuatum, .	Kilbride, Ballycastle, . . .	Yellow Sandstone.
,,	,,	Monaduff, Drumlish, . . .	,,
,,	cylindraceum,	Malahide, Malahide, ...	Carboniferous Slate & Arenaceous Limest.
,,	filiferum, . .	Lisnapaste, Balliatra, . . .	Carboniferous Slate.
Loxoceras	incomitatum,	Cove, Cork, ...	,,
,,	laterale, . .	Lisnapaste, Ballintra, . . .	,,
,,	,,	Drumscraw, Drumquin, . .	Yellow Sandstone.
Actinoceras	giganteum, .	Castle Espie, Comber, . . .	Arenaceous Limestone.
,,	pyramidatum,	Castle Espie, Comber, . . .	Arenaceous Limestone.
Phragmoceras	flexistria, . .	Killyclogby, Lisbellaw, . . .	Yellow Sandstone.
NAUTILIDÆ.			
Goniatites	Gibsoni, . .	Ballinacourty, Dungarvan, .	Carboniferous Slate.
,,	intercostalis, .	Crosspatrick, Killala, . . .	,,
,,	reticulatus, .	Mullaghtinny, Clogher, . .	,,
,,	striatus, . .	Drumscraw, Drumquin, . .	Yellow Sandstone.
,,	striolatus, . .	Ballinacourty, Dungarvan,	Carboniferous Slate.
,,	,,	Kinsale, ...	Carboniferous Slate or Yellow Sandstone.
Clymenia	sagittalis, . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
Discites	oxystomus, .	Drumscraw, Drumquin, . .	,,
,,	sulcatus, . .	Mullaghfarry, Killala, . . .	Carboniferous Slate.
,,	,,	Ring, Enniskillen, ...	Carboniferous Slate & Arenaceous Limest.
,,	,,	Crosspatrick, Killala, . . .	,,
,,	,,	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	tetragonus, .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Lisnapaste, Ballintra, . . .	Carboniferous Slate
Temnocheilus	biangulatus, .	Granard, Granard, ...	Yellow Sandstone and Arenaceous Limest.
,,	porcatus, . .	Townparks, Killeshandra, .	Yellow Sandstone.
,,	tuberculatus, .	Kilbride, Ballycastle, . . .	,,

* Arenaceous Shale is not specified, but included under the term Yellow Sandstone, with which it frequently alternates.

Names of Fossils.		Localities and Post-Towns.	Subdivision.
Genera.	Species.		
Bellerephon	apertus, . .	Horath, Moynalty.	Limestone of the Carboniferous Slate.
,,	,,	Lackagh, Drumquin. . . .	Carboniferous Slate.
,,	,,	Drumscraw, Drumquin. . .	Yellow Sandstone.
,,	cornu-arietis,	Magherenny, Drumquin. . .	Carboniferous Slate.
,,	hiulcus, . . .	Killaghtee, Dunkineely. . .	Yellow Sandstone and Arenaceous Limest.
GASTEROPODA.			
PECTINIBRANCHIATA, DIVIDED INTO ZOOPHAGA & PHYTOPHAGA.			
Macrocheilus	canaliculatus,	Kilcummin, Killala Bay, . .	Yellow Sandstone.
,,	curvilineus, .	Bruckless, Dunkineely, . . .	,,
,,	fimbriatus, .	Dromard, Draperstown, . .	,,
,,	ovalis, . . .	Bruckless, Dunkineely, . . .	,,
Loxonema	constricta, . .	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	polygyra, . .	Cullion, Draperstown, . . .	Yellow Sandstone.
,,	pulcherrima, .	Lackagh, Drumquin, . . .	,,
,,	sulcatula, .	Carrickoughter, Kesh, . . .	,,
,,	sulculosa, . .	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	tumida, . . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Poulscadden, Howth, . . .	Carboniferous Slate.
Turritella	acicula, . . .	Drumquin, ...	Arenaceous Limestone.
,,	tenuistria, . .	Horath, Moynalty, ...	Limestone of the Carboniferous Slate.
Turbo	spirata, . . .	Killala, Killala, ...	Carboniferous Slate.
Naticopsis	elongata, . .	Castle Espie, Comber, . . .	Arenacous Limesteone.
,,	plicistria, . .	Swellan, Cavan, ...	Limestone of the Carboniferous Slate.
,,	,,	Fivemiletown, Fivemiletown,	,,
,,	spirata, . . .	Horath, Moynalty, ...	,,
,,	,,	Tinnycahill, Donegal, . . .	Yellow Sandstone and Arenaceous Limest.
Euomphalus	acutus, . . .	Malahide, Malahide, ...	Carboniferous Slate.
,,	æqualis, . .	Countenan, Stradone, . . .	Yellow Sandstone.
,,	,,	Bruckless, Dunkineely, . . .	,,
,,	,,	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	calyx, . . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	catillus, . . .	Granard, Granard, ...	,,
,,	,,	Horath, Moynalty, ...	Limestone of the Carboniferous Slate.
,,	elongatus, . .	Ballinglen, Ballycastle, . . .	Yellow Sandstone.
,,	marginatus, .	Balsitric, Nobber, ...	,,
,,	pentangulatus,	Ring, Enniskillen, ...	Limestone of the Carboniferous Slate.
,,			
,,	,,	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Rahan's Bay, Dunkineely, .	,,

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
Euomphalus	quadratus, . .	Mullaghtinny, Clogher, . .	Carboniferous Slate.
,,	rotundatus, .	Malahide, Malahide, ...	,,
,,	serpens, . . .	Clonea, Dungarvan, ...	,,
,,	,,	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	tabulatus, . .	Lackagh, Drumquin, . . .	Yellow Sandstone and Arenaceous Limest.
,,	,,	Granard, Granard, ...	,,
,,	,,	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
Pleurotomaria	altavittata, .	Drumgowna, Kesh, ...	Yellow Sandstone.
,,	canaliculata, .	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	,,	Doorin, Donegal, ...	Yellow Sandstone.
,,	,,	Bruckless, Dunkineely, . . .	,,
,,	concentrica, .	Ring, Enniskillen, ...	Limestone of the Carboniferous Slate.
,,	conica, . . .	Donegal, Donegal, ...	Yellow Sandstone.
,,	tornatilis, .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
Murchisonia	elongata, . .	Dromard, Draperstown, . .	Yellow Sandstone.
,,	Larcomi, . .	Leam, Moneyburn River, . .	Limestone of the Carboniferous Slate.
Elenchus	antiquus, . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
SCUTIBRANCHIA AND CYCLOBRANCHIA.			
Fissurella	elongata, . .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
Acroculia	Sigmoidalis, .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	triloba, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
,,	tubifer, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	vetusta, . .	,,	,,
Patella	mucronata, .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	scutiformis, .	Lackagh, Drumquin, . . .	,,
DITHYRA.			
MACROTRACHIA.			
Teredo (?)	antiqua, . .	Fasglassagh, Ballygawley, .	Limestone of the Carboniferous Slate.
Sanguinolites	angustatus, .	Tinnycahill, Donegal, . . .	,,
,,	,,	Lackagh, Drumquin, . . .	Yellow Sandstone.
,,	,,	Bruckless, Dunkineely, . .	,,
,,	,,	Poulscadden, Howth, . . .	Carboniferous Slate.
,,	arcuatus, . .	Ring, Enniskillen, ...	Limestone of the Carboniferous Slate.
,,	costellatus, .	Killycloghy, Lisbellaw, . .	Yellow Sandstone.
,,	discors, . . .	Bruckless, Dunkineely, . . .	,,
,,	Iridinoides, .	Drumquin, Drumquin, . . .	,,

Names of Fossils.		Localities and Post-Towns.	Subdivision.
Genera.	Species.		
Sanguinolites	Iridinoides, .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	plicatus, . .	Lackagh, Drumquin, . . .	Yellow Sandstone.
,,	,,	Bruckless, Dunkineely, . .	,,
,,	,,	Bunatrahir, ...	,,
,,	sulcatus, . .	Kilbride, Ballycastle, . . .	,,
,,	transversus, .	Kilcummin, Lackan Bay, .	,,
,,	tricostatus, .	Killala, Killala, ...	Carboniferous Slate.
,,	undatus, . .	Mullaghtinny, Clogher, . .	,,
Anatina	attenuata, . .	Townplots, Killala, ...	,,
,,	deltoidea, . .	,, ,, ...	,,
Pandora	clavata, . .	Carrowmacrory, Tobercurry,	Yellow Sandstone.
Mactra	ovata, . . .	Killala, Killala, ...	Carboniferous Slate.
Kellia	gregaria, . .	Cultra, Hollywood, ...	Yellow Sandstone.
Venus	centralis, . .	Cullion, Draperstown, . . .	,,
,,	tenuistriata, .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
Pullastra	bistriata, . .	Poulscadden, Howth, . . .	,,
,,	crassistria, .	Crosspatrick, Killala, . . .	,,
,,	elliptica, . .	Bruckless, Dunkineely, . .	Yellow Sandstone.
,,	,,	Drumquin, Drumquin, . . .	Carboniferous Slate.
,,	ovalis, . . .	Lisnapaste, Ballintra, . . .	,,
Astarte	gibbosa, . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	quadrata, . .	Ballymeeny, Easky, ...	Carboniferous Slate.
Cyprina	Egertoni, . .	Horath, Moynalty, ...	Yellow Sandstone.
,,	,,	Bruckless, Dunkineely, . .	,,
Pleurorhynchus	aliformis, . .	Howth, Howth, ...	Carboniferous Slate.
,,	,,	Poulscadden, Howth, . . .	,,
,,	,,	Hook Head, Fethard, . . .	,,
,,	,,	Malahide, Malahide, ...	,,
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	armatus, . .	Poulscadden, Howth, . .	,,
,,	fusiformis, .	Malahide, Malahide.	,,
,,	,,	,, ,, ...	,,
,,	giganteus, .	St. John's Point, Dunkineely,	,,
,,	,,	Balsitric, Nobber, ...	Yellow Sandstone.
,,	,,	Mullylusty, Carrickmacross,	,,
,,	minax, . . .	Bruckless, Dunkineely, . .	,,
,,	,,	Poulscadden, Howth, . . .	Carboniferous Slate.
,,	trigonalis, .	Lisnapaste, Ballintra, . . .	,,
Cypricardia	alata, . . .	Arraglin Bridge, Kilworth, .	Yellow Sandstone.
,,	,,	Bruckless, Dunkineely, . .	,,
,,	concinna, . .	Cullion, Draperstown, . . .	,,
,,	cylindrica, .	Arraglin Bridge, Kilworth, .	,,
,,	minima, . .	Cullion, Draperstown, . . .	,,
,,	Modiolaris, .	Townplots, Killala, . . .	Limestone of the Carboniferous Slate.
,,	oblonga, . .	Arraglin Bridge, Kilworth, .	Yellow Sandstone.
,,	quadrata, . .	,, ,, .	,,
,,	rhombea, . .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	,,	Lackagh, Drumquin, . . .	Yellow Sandstone.
,,	sinuata, . .	Arraglin Bridge, Kilworth, .	,,
,,	socialis, . .	Leam, Tempo, ...	Limest. of Carb. Slate.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
Cypricardia	tumida, . .	Larganmore, Bangor, . . .	Yellow Sandstone.
Sedgwickia	attenuata, .	River Banagh, Drumcurren,	,,
,,	bullata, . .	Cullion, Draperstown, . . .	,,
,,	gigantea, . .	Carrowmacrory, Templeboy,	,,
,,	globosa, . .	Cullion, Draperstown, . . .	,,
Axinus	axiniformis, .	Mullaghtinny, Clogher, . .	Carboniferous Slate.
,,	,,	Larganmore, Bangor, . . .	Yellow Sandstone.
,,	carbonarius, .	,, ,, . . .	,,
,,	,,	Kilcummin, Lackan Bay, .	,,
,,	centralis, . .	Ardshankill, Boa Island, . .	,,
,,	deltoideus, .	Bruckless, Dunkineely, . .	,,
,,	nuculoides, .	Dromard, Draperstown, . .	,,
,,	obliquus, . .	Mullaghtinny, Clogher, . .	Carboniferous Slate.
,,	obovatus, . .	,, ,, . .	,,
Dolabra	attenuata, .	Derrylief, Cork, ...	Yellow Sandstone.
,,	equilateralis,	Doorin, Donegal, ...	,,
,,	gregaria, . .	Mullaghtinny, Clogher, . .	Carboniferous Slate.
,,	orbicularis, .	*See* Axinus centralis, . . .	Yellow Sandstone.
,,	securiformis,	Rahan's Bay, Dunkineely, .	,,
ATRACHIA.			
Nucula	attenuata, .	Drumquin, Drumquin, . . .	,,
,,	birostrata, .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	brevirostris, .	Drumquin, Drumquin, . . .	Yellow Sandstone.
,,	carinata, . .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	clavata, . .	Bruckless, Dunkineely, . .	Yellow Sandstone.
,,	cylindrica, .	Townparks, Killeshandra, .	,,
,,	gibbosa, . .	Bruckless, Dunkineely, . .	,,
,,	,,	Lackagh, Drumquin, . . .	,,
,,	leiorhynchus,	Larganmore, Bangor, . . .	,,
,,	longirostris, .	Mullaghtinny, Clogher, . .	Carboniferous Slate.
,,	oblonga, . .	Monaduff, Drumlish, . . .	Yellow Sandstone.
,,	Phillipsii, . .	Bruckless, Dunkineely, . .	,,
,,	,,	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	rectangularis,	,, ,, . . .	,,
,,	stilla, . . .	Dromard, Draperstown, . .	Yellow Sandstone.
,,	unilateralis, .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
Cucullæa	tenuistria, . .	Ballybodonnell, Dunkineely,	Yellow Sandstone.
Byssoarca	lanceolata, .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
Crenella	acutirostris, .	Bruckless, Dunkineely, . .	Yellow Sandstone.
Modiola	amygdalina, .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	concinna, . .	Townparks, Killeshandra, .	Yellow Sandstone.
,,	divisa, . . .	Larganmore, Bangor, . . .	Carboniferous Slate.
,,	lingualis, . .	Bruckless, Dunkineely, . .	Yellow Sandstone.
,,	Macadami, .	Aghnaglogh, Clogher, . . .	Carboniferous Slate.
,,	megaloba, . .	*See* Axinus centralis, . . .	Yellow Sandstone.
,,	subparallela, .	Ballinglen, Ballycastle, . .	,,
Mytilus	comptus, . .	Carrowmacrory, Tobercurry,	Carboniferous Slate.
Inoceramus	vetustus, . .	Killaghtee, Dunkineely, . .	Yellow Sandstone.
Meleagrina	rigida, . . .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
Meleagrina	tesselata, . .	St. Doolough's, Dublin, . .	Carboniferous Slate.
Pteronites	angustatus, .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	ventricosus, .	*See* Axinus centralis, . . .	
Avicula	angusta, . .	Rahan's Bay, Dunkineely, .	"
"	cycloptera, .	Mohill, Mohill, ...	Carboniferous Slate.
"	informis, . .	Killogunra, Killala, ...	"
"	laminosa, . .	Bruckless, Dunkineely, . .	Yellow Sandstone.
"	Thompsoni, .	Rahoran, Fivemiletown, . .	Carboniferous Slate.
"	Verneuillii, .	Drumcurren, Kesh, ...	Yellow Sandstone.
Pinna	flexicostata, .	Bunowna, Easky, ...	Carboniferous Slate.
"	mutica, . . .	Kilbride, Ballycastle, . . .	Yellow Sandstone.
Lingula	squamiformis,	Leam, Tempo, ...	Carboniferous Slate.
Malleus	orbicularis, .	FearnaghtLough,RiverMohill,	"
Lima	concinna, . .	Ballinglen, Ballycastle, . .	Yellow Sandstone.
"	planicostata,	Bruckless, Dunkineely, . .	"
Pecten	arachnoideus,	Brickeen Bridge, Killarney,	Carboniferous Slate.
"	"	Ballinacourty, Dungarvan, .	"
"	bellis, . . .	Rahoran, Fivemiletown, . .	"
"	concavus, . .	Killogunra, Killala, ...	"
"	conoideus, . .	Townplots, Killala, ...	"
"	consimilis, .	*See* Atrypa nana, ...	"
"	depilis, . . .	Townplots, Killala, ...	"
"	duplicicosta, .	Larganmore, Bangor, . . .	"
"	ellipticus, . .	Countenan, Stradone, . . .	Yellow Sandstone.
"	"	Bruckless, Dunkineely, . .	"
"	"	Doorin, Donegal, ...	"
"	fallax, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Rahan's Bay, Dunkineely, .	Yellow Sandstone.
"	"	Malahide, Malahide, . . .	Carboniferous Slate.
"	granosus, . .	St. Doolough's, Dublin, . .	?
"	granulosus, .	Greaghs, Ballintra, ...	"
"	"	Clonea, Dungarvan, ...	"
"	Hardingii, .	Lisnapaste, Ballintra, . . .	"
"	incrassatus, .	" " . . .	"
"	interstitialis, .	Bruckless, Dunkineely, . .	Yellow Sandstone.
"	"	Kilbride, Ballycastle, . . .	"
"	irregularis, .	Rahoran, Fivemiletown, . .	Carboniferous Slate.
"	Knockonniensis, ...	Knockonny, Ballygawley, .	"
"	macrotis, . .	Bruckless, Dunkineely, . .	Yellow Sandstone.
"	megalotis, . .	Poulscadden, Howth, . . .	Carboniferous Slate.
"	micropterus, .	Killycloghy, Lisbellaw, . .	"
"	mundus, . .	Lisnapaste, Ballintra, . . .	"
"	Murchisoni, . .	" " . . .	"
"	"	Townparks, Killeshandra, .	Yellow Sandstone.
"	pera, ...	Townplots, Killala, ...	Carboniferous Slate.
"	plicatus, . .	Mohill, Mohill, ...	Limestone of the Carboniferous Slate.
"	polytrichus, .	Bruckless, Dunkineely, . .	Yellow Sandstone.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
Pecten	quinquelineatus, . . .	Mohill, Mohill, 2	Carboniferous Slate.
"	rugulosus, .	Doorin, Donegal, 2	Yellow Sandstone.
"	semicircularis,	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
"	"	Bruckless, Dunkineely, . .	Yellow Sandstone.
"	scalaris, . .	Mohill, Mohill, ...	Carboniferous Slate.
"	serratus, . .	Lisnapaste, Ballintra, . . .	"
"	simplex, . .	Cullion, Draperstown, . . .	Yellow Sandstone.
"	Sowerbii, . .	Bruckless, Dunkineely, . .	"
"	"	Mohill, Mohill, ...	Carboniferous Slate.
"	"	Lisnapaste, Ballintra, . . .	"
"	spinulosus, .	Bruckless, Dunkineely, . .	Yellow Sandstone.
"	transversus, .	Clonea, Dungarvan, ...	Carboniferous Slate.
"	undulatus, .	Lisnapaste, Ballintra, . . .	"
Monotis	æqualis, . .	Cullion, Draperstown, . . .	Yellow Sandstone.
BRACHIOPODA.			
Orbicula	quadrata, . .	Rahan's Bay, Dunkineely, .	"
"	trigonalis, .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
Producta	aculeata, . .	Kilbride, Ballycastle, . . .	Yellow Sandstone.
"	"	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	antiquata, .	Lisnapaste, Ballintra, . . .	"
"	caperata, . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Currens, Castle Island, . .	Carboniferous Slate.
"	"	Clonea, Dungarvan, ...	"
"	"	Doorin, Donegal, ...	Yellow Sandstone.
"	"	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	"	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	concinna, . .	Bruckless, Dunkineely, . .	Yellow Sandstone.
"	"	Drumscraw, Drumquin, . .	"
"	"	Malahide, Malahide, . . .	Carboniferous Slate.
"	"	Lisnapaste, Ballintra, . . .	"
"	"	Poulscadden, Howth, . . .	"
"	corrugata, .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Mohill, Mohill, ...	Carboniferous Slate.
"	"	Rahan's Bay, Dunkineely, .	Yellow Sandstone.
"	elegans, . .	Bruckless, Dunkineely, . .	"
"	fimbriata, . .	Kilbride, Ballycastle, . . .	"
"	fragaria, . .	Poulscadden, Howth, . . .	Carboniferous Slate.
"	"	Clonea, Dungarvan, ...	"
"	gigantea, . .	Castle Espie, Comber, . . .	Arenaceous Limestone.
"	granulosa, .	Poulscadden, Howth, . . .	Carboniferous Slate.
"	hemispherica,	Lackagh, Drumquin, . . .	Yellow Sandstone.
"	"	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
"	interrupta, .	Ballinacourty, Dungarvan, .	"
"	latissima, . .	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.

Names of Fossils.		Localities and Post-Towns.	Subdivision.
Genera.	Species.		
Producta	laxispina, . .	Castle Espie, Comber, . . .	Arenaceous Limestone.
,,	lobata, . . .	Bruckless, Dunkineely, . .	Yellow Sandstone.
,,	,,	Lackagh, Drumquin, . . .	,,
,,	longispina, .	Mohill, Mohill, ...	Carboniferous Slate.
,,	,,	Poulscadden, Howth, . . .	,,
,,	,,	Lisnapaste, Ballintra, . . .	,,
,,	margaritacea,	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	,,	Mohill, Mohill, ...	,,
,,	Martini, . .	Lackagh, Drumquin, . . .	,,
,,	,,	Newcastle, Clogheen, . . .	,,
,,	membranacea,	Ballinacourty, Dungarvan, .	,,
,,	,,	Lisnapaste, Ballintra, . . .	,,
,,	mesoloba, . .	Townparks, Killeshandra, .	Yellow Sandstone.
,,	ovalis, . . .	Donegal, Donegal, ...	,,
,,	pectinoides, .	Greagh's, Ballintra, ...	Carboniferous Slate.
,,	,,	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	prælonga, . .	Cregganore, Gort, ...	Yellow Sandstone.
,,	,,	Clonea, Dungarvan, ...	Carboniferous Slate.
,,	pugilis, . . .	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	,,	Mohill, Mohill, ...	Carboniferous Slate.
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,			
,,	,,	Malahide, Malahide, . . .	Carboniferous Slate.
,,	punctata, . .	Lackagh, Drumquin, . . .	,,
,,	,,	Malahide, Malahide, ...	,,
,,	pustulosa, . .	Lisnapaste, Ballintra, . . .	,,
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Poulscadden, Howth, . . .	Carboniferous Slate.
,,	quincuncialis,	Granard, Granard, ...	Yellow Sandstone and Arenaceous Limest.
,,	,,	Townparks, Killeshandra, .	Yellow Sandstone.
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
,,	,,	Mohill, Mohill, ...	,,
,,	rugata, . . .	Poulscadden, Howth, . . .	,,
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	scabricula, .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Poulscadden, Howth, . . .	Carboniferous Slate.
,,	,,	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	,,	Malahide, Malahide, ...	,,
,,	,,	Mohill, Mohill, ...	,,
,,	Scotica, . .	Drumkeeran, Ederny, . . .	Yellow Sandstone.
,,	,,	Scraghy, Castlederg, ...	,,
,,	,,	Dromore, Omagh, ...	,,
,,	,,	Castle Espie, Comber, . . .	Arenaceous Limestone.
,,	setosa, . . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
Producta	setosa, . . .	Cregganore, Gort, ...	Yellow Sandstone.
,,	,,	Hook Head, Fethard, . .	Limestone of the Carboniferous Slate.
,,	,,	Mohill, Mohill, ...	Carboniferous Slate.
,,	,,	Malahide, Malahide, ...	,,
,,	,,	Lisnapaste, Ballintra, . . .	,,
,,	,,	Poulscadden, Howth, . . .	,,
,,	spinosa, . . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
,,	,,	Laragh, Stradone, ...	Yellow Sandstone.
,,	sulcata, . . .	Mohill, Mohill, ...	Carboniferous Slate.
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	,,	Rahan's Bay, Dunkineely, .	Yellow Sandstone.
,,	,,	Bruckless, Dunkineely, . . .	,,
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
Leptagonia	analoga, . .	Clonea, Dungarvan, ...	,,
,,	,,	Currens, Castle Island, . . .	,,
,,	,,	Lisnapaste, Ballintra, . . .	,,
,,	,,	Ring, Enniskillen, ...	,,
,,	,,	Stridagh Point, Donegal, . .	,,
,,	,,	Malahide, Malahide, ...	,,
,,	nodulosa, . .	Currens, Castle Island, . . .	,,
,,	,,	Kilnamack, Clonmel, . . .	,,
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	rugosa, . . .	Ballinacourty, Dungarvan, .	Carboniferous Slate.
Leptæna	convoluta, . .	Lisnapaste, Ballintra, . . .	,,
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	Dalmaniana,	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	Hardrensis, .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	,,	Mohill, Mohill, ...	,,
,,	lata ?	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	multidentata,	Ballybodonnell, Dunkineely, .	,,
,,	,,	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	perlata, . .	Rahoran, Fivemiletown, . .	Carboniferous Slate.
,,	plicata, . . .	Ardoe, Ardmore, ...	,,
,,	,,	Clonea, Dungarvan, ...	,,
,,	,,	Lisnapaste, Ballintra, . . .	,,
,,	sericea ? . .	,, ,,	,,
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	sordida, . .	Lisnapaste, Ballintra, . . .	,,
,,	,,	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	volva, . . .	St. Doolough's, Dublin, . .	Limestone of the Carboniferous Slate.
,,	,,	Poulscadden, Howth, . . .	Carboniferous Slate.

Names of Fossils. Genera.	Names of Fossils. Species.	Localities and Post-Towns.	Subdivision.
Orthis	arachnoidea, .	Curragh, Ardmore, ...	Carboniferous Slate.
"	"	Shanbally, Cork, ...	"
"	arcuata, . .	Cregganore, Gort, ...	Yellow Sandstone.
"	"	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	"	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
"	Bechei, . . .	Whiting Bay, Youghal, . .	Carboniferous Slate.
"	caduca, . . .	Rahoran, Fivemiletown, . .	"
"	circularis, . .	Lisnapaste, Ballintra, . . .	"
"	comata, . . .	Currens, Tralee, ...	"
"	crenistria, . .	Rahan's Bay, Dunkineely, .	Yellow Sandstone.
"	"	Cregganore, Gort, ...	"
"	"	Ardloughill, Ballyshannon, .	"
"	"	Currens, Castle Island, . . .	Carboniferous Slate.
"	"	Edenassop, Tyrone, ...	Yellow Sandstone.
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	St. John's Point, Dunkineely,	"
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	"	Poulscadden, Howth, . . .	"
"	cylindrica, .	Castle Espie, Comber, . . .	Arenaceous Limestone.
"	filiaria, . . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Poulscadden, Howth, . . .	Carboniferous Slate.
"	"	Clonea, Dungarvan, ...	"
"	"	Malahide, Malahide, ...	"
"	granulosa, .	Doorin, Donegal, ...	Yellow Sandstone.
"	"	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	"	Poulscadden, Howth, . . .	"
"	"	Clonea, Dungarvan, ...	"
"	"	Lisnapaste, Ballintra, . . .	"
"	"	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	interlineata, .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
	"		
"	"	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	"	Dunally, ...	Yellow Sandstone.
"	"	Currens, Castle Island, . . .	Carboniferous Slate.
"	"	Lisnapaste, Ballintra, . . .	"
"	"	Poulscadden, Howth, . . .	"
"	latissima, . .	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
"	"	Rahan's Bay, Dunkineely, .	Yellow Sandstone.
"	longisulcata, .	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	"	Poulscadden, Howth, . . .	"
"	papilionacea, .	Drumquin, Drumquin, . . .	Yellow Sandstone.
"	"	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
"	"	Swellan, Cavan, ...	Yellow Sandstone.
"	"	Townparks, Killeshandra, . .	"
"	"	Rahan's Bay, Dunkineely, .	"
"	"	Granard, Granard, ...	Yellow Sandstone and Arenaceous Limest.

Names of Fossils.		Localities and Post-Towns.	Subdivision.
Genera.	Species.		
Orthis	papilionacea, .	Ederny, Fermanagh, ...	Yellow Sandstone.
"	"	Scraghy, Castlederg, ...	"
"	parallela, . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Mohill, Mohill, ...	Carboniferous Slate.
"	"	Curragh, Ardmore, ...	"
"	"	Clonea, Dungarvan, ...	"
"	"	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
"	"	Kilbride, Ballycastle, . . .	Arenaceous Limestone.
"	"	Poulscadden, Howth, . . .	Carboniferous Slate.
"	radialis, . . .	Stridagh Point, Donegal, . .	"
"	resupinata, .	Townparks, Killeshandra, . .	Yellow Sandstone.
"	"	Bruckless, Dunkineely, . . .	"
"	"	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
"	"	Poulscadden, Howth, . . .	Carboniferous Slate.
"	semicircularis,	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Clonea, Dungarvan, ...	Carboniferous Slate.
"	"	Poulscadden, Howth, . . .	"
"	sulcata, . . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	tenuistriata ? .	Currens, Castle Island, . . .	Carboniferous Slate.
"	"	Shanbally, Cork, ...	"
Spirifera	aperturata, .	Ardoe, Ardmore, ...	"
"	"	Clonea, Dungarvan, ...	"
"	attenuata, . .	Malahide, Malahide, ...	"
"	"	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Ring, Enniskillen, ...	Carboniferous Slate.
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Clonea, Dungarvan, ...	Carboniferous Slate.
"	"	Ballinacourty, Dungarvan, .	"
"	"	Poulscadden, Howth, . . .	"
"	bisulcata, . .	Granard, Granard, ...	Yellow Sandstone and Arenaceous Limest.
"	"	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Slieve Gallion, Magherafelt, .	Yellow Sandstone.
"	calcarata, . .	Kilbride, Ballycastle, . . .	Arenaceous Limestone.
"	"	Granard, Granard, ...	Yellow Sandstone and Arenaceous Limest.
"	"	Derrybryan, Co. Clare, . . .	Yellow Sandstone.
"	"	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Dunally, ...	Carboniferous Slate.
"	"	Malahide, Malahide, ...	"
"	clathrata, . .	Lisnapaste, Ballintra, . . .	"
"	crispa, . . .	Cregganore, Gort, ...	Yellow Sandstone.
"	"	Kilnamack, Clonmel, . . .	Carboniferous Slate.

Names of Fossils. Genera.	Specie.	Localities and Post-Towns.	Subdivision.
Spirifera	crispa,	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
"	"	Malahide, Malahide, ...	"
"	disjuncta, . .	Kilnamack, Clonmel, . . .	"
"	"	Clonea Castle, Dungarvan, .	"
"	"	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Whiting Bay, Youghal, . .	Carboniferous Slate.
"	"	Malahide, Malahide, ...	"
"	"	Reendonoughan, Bantry, . .	"
"	"	Poulscadden, Howth, ...	"
"	gigantea, . .	Mohill, Mohill, ...	"
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Donegal, Donegal, ...	Yellow Sandstone.
"	grandæva, . .	Rinniskiddy, Cork, ...	Carboniferous Slate.
"	"	Lisnapaste, Ballintra, . . .	"
"	"	Shanbally, Carrigaline, . . .	"
"	"	Castleogary, ...	"
"	inornata, . .	Cregganore, Gort, ...	Yellow Sandstone.
"	"	Shanbally, Cork, ...	Carboniferous Slate.
"	megaloba, . .	Currens, Castle Island, . . .	"
"	minima, . . .	Clonkeiffy, Virginia, ...	
"	octoplicata, . .	Rahan's Bay, Dunkineely, . .	Yellow Sandstone.
"	"	Ballinacourty, Dungarvan, .	"
"	ostiolata, . .	Hookhead, Fethard, ...	Limestone of the Carboniferous Slate.
"	"	Monaghan, Monaghan, . . .	
"	"	Clonea, Dungarvan, ...	Carboniferous Slate.
"	"	Mohill, Mohill, ...	"
"	"	Horath, Moynalty, ...	Limestone of the Carboniferous Slate.
"	"	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	rhomboidea, .	Lisnapaste, Ballintra, . . .	"
"	"	Ballinacourty, Dungarvan, .	"
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	rotundata, . .	Clonea, Dungarvan, ...	Carboniferous Slate.
"	"	Malahide, Malahide, ...	"
"	rudis, ...	Ballinacourty, Dungarvan, .	"
"	"	Poulscadden, Howth, . . .	"
"	speciosa, . . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Doorin, Donegal, ...	"
"	"	Rahan's Bay, Dunkineely, .	"
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	Urii, . . .	Lisnapaste, Ballintra, . . .	"
Cyrtia	cuspidata, . .	Doorin, Donegal, ...	Yellow Sandstone.
"	"	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
"	"	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
Cyrtia	cuspidata, . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Curragh, Ardmore, ...	Carboniferous Slate.
"	"	Newcastle, Clogheen,. . . .	"
"	"	Currens, Castle Island, . . .	"
"	"	Malahide, Malahide, ...	"
"	distans, . . .	Hook Head, Fethard,. . . .	Limestone of the Carboniferous Slate.
"	"	Currens, Castle Island, . . .	Carboniferous Slate.
"	"	Kilnamack, Clonmel, . . .	"
"	"	Tinnycahill, Donegal, . . .	Yellow Sandstone and Arenaceous Limest.
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	"	Rahan's Bay, Dunkineely, . .	Yellow Sandstone.
"	"	Poulscadden, Howth, . . .	Carboniferous Slate.
"	laminosa, . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	"	Stridagh Point, Donegal, . .	"
"	"	Poulscadden, Howth, . . .	"
"	"	Malahide, Malahide, ...	"
"	linguifera, . .	Granard, Granard, ...	Yellow Sandstone and Arenaceous Slate.
"	mesogonia, .	Hook Head, Fethard, ...	Limestone of the Carboniferous Slate.
"	nuda, ...	Clonea, Dungarvan, ...	Carboniferous Slate.
"	"	Rinniskiddy, Cork, ...	"
"	semicircularis,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Mohill, Mohill, ...	Carboniferous Slate.
"	"	Malahide, Malahide, ...	"
"	simplex, . . .	" "	"
"	"	Lisnapaste, Ballintra,. . . .	"
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	St. John's Point, Dunkineely,	"
Martinia	decora, . . .	Clonea Castle, Dungarvan Bay,	Carboniferous Slate.
"	elliptica, . .	Ballybodonnell, Dunkineely,	Yellow Sandstone.
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	glabra, . . .	Clonea Castle, Dungarvan Bay,	"
"	phalæna, . .	St. Doolough's, Dublin, . .	"
"	"	Ballinacourty, Dungarvan, .	"
"	"	Clonea, Dungarvan, ...	"
"	plebeia, . . .	Hook Head, Fethard,. . . .	"
"	"	Tullyard, Armagh, ...	Lower Limestone.
"	"	Lisnapaste, Ballintra, . . .	"
"	strigocephaloides,	" " . . .	"
Reticularia,	imbricata, . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Ring, Enniskillen, ...	Carboniferous Slate.
"	"	Mohill, Mohill, ...	"

Names of Fossils.		Localities and Post-Towns.	Subdivision.
Genera.	Species.		
Reticularia	imbricata, . .	Hook Head, Fethard,. . . .	Limestone of the Carboniferous Slate.
,,	lineata, . . .	Doorin, Donegal, ...	Yellow Sandstone.
,,	microgemma, .	Mohill, Mohill, ...	Carboniferous Slate.
,,	,,	Malahide, Malahide, ...	,,
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Poulscadden, Howth, . . .	Carboniferous Slate.
,,	striatella, . .	Termon, Boyle, ...	Lower Limestone.
Brachythyris	duplicicosta, .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,, .	Killaghtee, Dunkineely, . .	,,
,,	,,	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	,,	Malahide, Malahide, ...	,,
,,	integricosta, .	Mohill, Mohill, ...	,,
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	ovalis, . . .	Ballinacourty, Dungarvan, .	,,
,,	pinguis, . . .	Ballinacourty, Dungarvan, .	,,
,,	,,	Hook Head, Fethard, . . .	,,
,,	,,	Malahide, Malahide, ...	,,
,,	planata, . . .	St. Doulough's, Dublin, . .	Limestone of the Carboniferous Slate.
,,	planicostata, .	Bruckless, Dunkineely, . .	Yellow Sandstone.
Athyris	concentrica, .	Bruckless, Dunkineely, . .	,,
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Rathbale, Swords, ...	Carboniferous Slate.
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	,,	Poulscadden, Howth, . . .	,,
,,	decussata, . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Curragh, Ardmore, ...	Carboniferous Slate.
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Clonea, Dungarvan, ...	Carboniferous Slate.
,,	,,	Lisnapaste, Ballintra, . . .	,,
,,	,,	Currens, Castle Island, . . .	,,
,,	,,	Malahide, Malahide, ...	,,
,,	,,	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	,,	Poulscadden, Howth, ...	Carboniferous Slate.
,,	depressa, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Doorin, Donegal, ...	Yellow Sandstone.
,,	,,	Donegal, Donegal, ...	,,
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
,,	fimbriata, . .	Poulscadden, Howth, . . .	,,
,,	glabristria, .	Ballinacourty, Dungarvan, .	,,
,,	,,	Mohill, Mohill, ...	,,
,,	,,	Lough Esk, Donegal, . . .	Arenaceous Limestone.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.

Name of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
Athyris	globularis, . .	Clonea, Dungarvan, ...	Carboniferous Slate.
"	"	Kilbride, Ballycastle, . . .	Arenaceous Limestone.
"	hispida, . . .	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
"	"	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
"	planosulcata, .	Lackagh, Drumquin, ...	Yellow Sandstone.
"	"	Inver, Donegal, ...	Arenaceous Limestone.
"	squamosa, . .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Mohill, Mohill, ...	Carboniferous Slate.
"	triloba, . . .	Drumscraw, Drumquin, . .	Yellow Sandstone.
Atrypa	angularis, . .	Ballinglen, Ballycastle, . .	Arenaceous Limestone.
"	compta, . . .	Kilcummin, Killala Bay, . .	Carboniferous Slate.
"	desquamata, .	Clonea Castle, Dungarvan Bay	"
"	"	Ballinacourty, Dungarvan Bay	"
"	fallax, . . .	Ardoe, Ardmore, ...	"
"	"	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Kilnamack, Clonmel, . . .	Carboniferous Slate.
"	"	Currens, Castle Island, . . .	"
"	"	Cregganore, Gort, ...	Yellow Sandstone.
"	"	Poulscadden, Howth, . . .	Carboniferous Slate.
"	"	Fivemiletown, Fivemiletown,	"
"	flexistria, . .	St. Doolough's, Dublin, . .	Limestone of the Carboniferous Slate.
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	gregaria, . .	Kilbride, Ballycastle, . . .	Arenaceous Limestone.
"	hastata, . . .	Bruckless, Dunkineely, . .	Yellow Sandstone.
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	"	Poulscadden, Howth, . . .	"
"	indentata, . .	Larganmore, Bangor, . . .	Yellow Sandstone.
"	insperata, . .	Clonea, Dungarvan, . . .	Carboniferous Slate.
"	"	Ballinacourty, Dungarvan, .	"
"	juvenis, . . .	Cregganore, Gort, ...	Yellow Sandstone.
"	"	Bruckless, Dunkineely, . .	"
"	lachryma, . .	Malahide, Malahide, ...	Carboniferous Slate.
"	laticosta, . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Mohill, Mohill, ...	Carboniferous Slate.
"	nana, ...	Rahoran, Fivemiletown, . .	"
"	oblonga? . .	Clonea, Dungarvan, ...	"
"	pleurodon, . .	Cregganore, Gort, ...	Yellow Sandstone.
"	"	Bruckless, Dunkineely, . . .	"
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	prisca, . . .	Shanbally, Carrigaline, . . .	"
"	proava, . . .	Malahide, Malahide, ...	"
"	pugnus, . . .	St. Doolough's, Dublin, . .	Limestone of the Carboniferous Slate.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
Atrypa	pugnus, . . .	Inver, Donegal, ...	Arenaceous Limestone.
"	radialis, . . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Cregganore, Gort, ...	"
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	reniformis, . .	Lisnapaste, Ballintra, . . .	"
"	sacculus, . . .	Granard, Granard, ...	Yellow Sandstone and Arenaceous Limestone.
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	striatula, . .	Clonea, Dungarvan, ...	"
"	"	Rinniskiddy, Cork, ...	"
"	"	Curragh, Ardmore, ...	"
"	"	Ballinacourty, Dungarvan, .	"
"	sulcirostris, .	Carnly, Sligo, ...	"
"	"	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	triplex, . . .	Kildress, Cookstown, ...	"
"	ventilabrum, .	Malahide, Malahide, ...	Carboniferous Slate.
"	virgo, ...	Larganmore, Bangor, . . .	Yellow Sandstone.
CRUSTACEA.			
Calymene	granulata ? . .	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	lævis, ...	Clonea, Dungarvan, ...	"
"	Latreillii, . .	Clonea, Dungarvan, ...	"
Griffithides	obsoletus, . .	Kilbride, Ballycastle, . . .	Arenaceous Limestone.
Phillipsia	Colei, ...	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
"	gemmulifera, .	Poulscadden, Howth, . . .	"
"	"	Kilbride, Ballycastle, . . .	Arenaceous Limestone.
"	truncatula, . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Currens, Castle Island. . . .	Carboniferous Slate.
Dithyrocaris	Colei, ...	Aghnaglogh, Clogher, . . .	"
"	Scouleri, . . .	Aghnaglogh, Clogher, . . .	"
Bairdia	curtus, . . .	Granard, Granard, ...	Carboniferous Slate and Arenaceous Limest.
Cythere	arcuata, . . .	Dromard, Draperstown, . . .	Yellow Sandstone.
"	bituberculata, .	Cultra, Hollywood, ...	"
"	cornuta, . . .	Cultra, Hollywood, ...	"
"	costata, . . .	Cultra, Hollywood, ...	"
"	elongata, . .	Cultra, Hollywood, ...	"
"	excavata, . .	Aghnaglogh, Clogher, . . .	Carboniferous Slate.
"	Hibbertii, . .	Larganmore, Bangor, . . .	Yellow Sandstone.
"	impressa, . .	Dromard, Draperstown, . . .	"
"	inornata, . .	Cultra, Hollywood, ...	"
"	oblonga, . . .	Cullion, Draperstown, . . .	"
"	orbicularis, . .	Bunowna, Easky, ...	"
"	pusilla, . . .	Cullion, Draperstown, . . .	"
"	subrecta, . . .	Larganmore, Bangor, . . .	"
"	trituberculata,	Cultra, Hollywood, ...	"

Names of Fossils. Genera.	Species.	Localities and Post Towns.	Subdivision.
ANNELIDA.			
Serpula	scalaris, . . .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
Spirorbis	caperatus, . .	Hook Head, Fethard, . . .	"
"	globosus, . .	Aghnaglogh, Clogher, . . .	"
"	intermedius, .	Cultra, Hollywood, ...	Yellow Sandstone.
"	minutus, . . .	Aghnaglogh, Clogher, . . .	Carboniferous Slate.
"	omphalodes? .	Cultra, Hollywood, ...	Yellow Sandstone.
Spiroglyphus	marginatus, .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
Serpulites	membranaceus	St. Doolough's, Dublin, . . .	"
ECHINODERMATA.			
Palæchinus	elegans, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	gigas, ...	Hook Head, Fethard, . . .	"
"	"	Rahan's Bay, Dunkineely, .	Yellow Sandstone.
"	Königii. . . .	Rahan's Bay, Dunkineely, .	"
Echinocrinus	elegans, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	glabrispina, .	Hook Head, Fethard, . . .	"
"	"	Clonea, Dungarvan, ...	Carboniferous Slate.
"	triserialis, . .	Killycloghy, Lisbellaw, . . .	
"	Urii, ...	Townparks, Killeshandra, . .	Yellow Sandstone.
"	"	Lough Esk, Donegal, ...	Arenaceous Shale.
"	"	Rahan's Bay, Dunkineely, . .	Carboniferous Slate.
"	"	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
"	"	Malahide, Malahide, ...	Carboniferous Slate.
"	vetustus, . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
Adelocrinus	histrix, . . .	Ballinacourty, Dungarvan, .	Carboniferous Slate.
Platycrinus	contractus, . .	Cregganore, Gort, ...	Yellow Sandstone.
"	gigas, ...	Malahide, Malahide, ...	Carboniferous Slate.
"	granulatus, .	Ballinacourty, Dungarvan, .	"
"	interscapularis,	Ballinacourty, Dungarvan, .	"
"	"	Poulscadden, Howth, ...	"
"	laciniatus, . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	lævis, ...	Hook Head, Fethard, . . .	"
"	ornatus, . . .	Hook Head, Fethard, . . .	"
"	punctatus, . .	St. John's Point, Dunkineely,	"
"	similis, . . .	Ballinacourty, Dungarvan, .	Carboniferous Slate.
"	triacontadactylus, ...	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
Platycrinus	tuberculatus, .	Ballinacourty, Dungarvan, .	Carboniferous Slate.
Poteriocrinus	gracilis, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
Taxocrinus	macrodactylus,	Clonea, Dungarvan, ...	Carboniferous Slate.
"	"	Ballinacourty, Dungarvan, .	"
Cyathocrinus	ellipticus, . .	Ballinacourty, Dungarvan .	"

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
Cyathocrinus	ellipticus, .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	,,	Poulscadden, Howth, . . .	,,
,,	geometricus, .	Currens, Castle Island, . . .	,,
,,	,,	Curragh, Ardmore, ...	,,
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	inequidactylus,	Malahide, Malahide, ...	,,
,,	macrocheirus, .	Rahan's Bay, Dunkineely, .	Yellow Sandstone.
,,	megastylus, .	St. Doolough's, Dublin, . . .	Limestone of the Carboniferous Slate.
,,	,,	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
,,	,,	Mohill, Mohill, ...	,,
,,	ornatus, . . .	Malahide, Malahide, ...	,,
,,	pinnatus?	Lisnapaste, Ballintra, . . .	,,
,,	,,	Clonea, Dungarvan, ...	,,
,,	,,	St. Doolough's Dublin, . . .	Limestone of the Carboniferous Slate.
,,	,,	Ballinacourty, Dungarvan, .	Carboniferous Slate.
,,	tuberculatus, .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	variabilis, . .	Ballinacourty, Dungarvan, .	Carboniferous Slate.
,,	,,	Currens, Castle Island, . . .	,,
,,	,,	Knocklofty, Co. Tipperary, .	,,
,,	,,	Clonea, Dungarvan, ...	,,
,,	,,	Malahide, Malahide, ...	,,
,,	,,	Bruckless, Dunkineely, . . .	Yellow Sandstone.
Rhodocrinus	verus, ...	Poulscadden, Howth, . . .	Carboniferous Slate.
Actinocrinus	Gilbertsoni, .	Malahide, Malahide, ...	,,
,,	polydactylus, .	Ballinacourty, Dungarvan, .	,,
,,	pusillus, . . .	Malahide, Malahide, ...	,,
,,	tenuistriatus, .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Rahan's Bay, Dunkineely, .	,,
,,	,,	Ardoe, Ardmore, ...	Carboniferous Slate.
,,	,,	Clonea, Dungarvan, ...	,,
,,	,,	Lisnapaste, Ballintra, . . .	,,
,,	tesselatus, . .	Clonea, Dungarvan, ...	,,
,,	triacontadactylus, ...	Ballinacourty, Dungarvan, .	,,
,,	,,	Malahide, Malahide, ...	,,
Atocrinus	Milleri, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
ZOOPHYTA.			
Amplexus	nodulosus, . .	Clonea Castle, Dungarvan, .	Carboniferous Slate.
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	Sowerbii, . .	Ballinacourty, Dungarvan, .	,,
,,	,,	Clonea, Dungarvan, ...	,,
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
,,	tortuosus, . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Clonea Castle, Dungarvan Bay,	Carboniferous Slate.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision.
Turbinolopsis	bina?	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Currens, Castle Island, . . .	Carboniferous Slate.
,,	Celtica, . . .	Ballinacourty, Dungarvan, .	,,
,,	,,	Knocklofty, Co. Tipperary, .	,,
,,	,,	Clonea Castle, Dungarvan Bay,	,,
,,	panciradialis, .	Currens, Castle Island, . . .	,,
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	pluriradialis, .	Currens, Castle Island, . . .	,,
Turbinolia	fungites, . . .	Kilbride, Ballycastle, ...	Arenaceous Limestone.
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Slieve Gallion, Magherafelt, .	,,
,,	,,	Lisnapaste, Ballintra, . . .	,,
,,	,,	Poulscadden, Howth, ...	Carboniferous Slate.
,,	,,	Ballybodonnell, Dunkineely, .	Yellow Sandstone.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
Siphonophyllia	cylindrica, . .	Lackagh, Drumquin, ...	Yellow Sandstone.
,,	,,	Ardsallagh, Drumquin, . . .	Carboniferous Slate.
,,	,,	Scraghy, Castlederg, ...	,,
,,	,,	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Poulscadden, Howth, ...	Carboniferous Slate.
Astræa	irregularis, . .	Bunowna, Easky, ...	,,
,,	pentagona, . .	Larganmore, Bangor, . . .	Yellow Sandstone.
Lithodendron	affine, ...	Lackagh, Drumquin, ...	,,
,,	cæspitosum, .	Scraghy, Castlederg, ...	,,
,,	sexdecimale, .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	,,	Poulscadden, Howth, ...	Carboniferous Slate.
,,	,,	St. John's Point, Dunkineely,	Yellow Sandstone.
Syringopora	bifurcata, .	Poulscadden, Howth, ...	Carboniferous Slate.
,,	catenata, . .	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	geniculata, . .	Drumscraw, Drumquin, . . .	Yellow Sandstone.
,,	,,	Tinnycahill, Donegal, . . .	Yellow Sandstone and Arenaceus Limest.
,,	,,	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
,,	laxa, ...	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	ramulosa, . .	Raban's Bay, Dunkineely, .	,,
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
,,	,,	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
Aulopora	campanulata, .	Hook Head, Fethard, . . .	,,
Manon	cribrosum ?. .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
,,	,,	Clonea, Dungarvan, ...	Carboniferous Slate.
,,	,,	Ballinacourty, Dungarvan, .	,,
Astreopora	antiqua, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.

Names of Fossils. Genera.	Names of Fossils. Species.	Localities and Post-Towns.	Subdivision.
Dictyophyllia	antiqua, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
Pleurodictyum	problematicum?	Ballinacourty, Dungarvan, .	Carboniferous Slate.
,,	,,	Clonea, Dungarvan, ...	,,
,,	,,	Lisnapaste, Ballintra, . . .	,,
Favosites,	fibrosa, . . .	Clonea, Dungarvan, ...	,,
,,	,,	Curragh, Ardmore, ...	,,
,,	megastoma? .	Meenacarrigby, Drumquin, .	Yellow Sandstone.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
,,	,,	Scraghy, Drumquin, ...	,,
,,	,,	Poulscadden, Howth, . . .	,,
,,	polymorpha, .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
,,	serialis, . . .	Malahide, Malahide, ...	Carboniferous Slate.
,,	spongites, . .	Poulscadden, Howth, . . .	,,
,,	,,	Swellan, Cavan, ...	,,
,,	,,	Malahide, Malahide, ...	,,
,,	tenuisepta, . .	Lackagh, Drumquin, ...	Yellow Sandstone.
,,	,,	Mohill, Mohill, ...	Carboniferous Slate.
,,	,,	Poulscadden, Howth, ...	,,
,,	tumida, . . .	Lackagh, Drumquin, ...	Yellow Sandstone.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
Stromatopora	concentrica, .	Killybrone, Killala, ...	Arenaceous Limestone.
,,	,,	Malahide, Malahide, ...	Carboniferous Slate.
Verticillipora	abnormis? . .	Ballinacourty, Dungarvan, .	,,
,,	,,	Malahide, Malahide, ...	,,
,,	,,	Clonea, Dungarvan, ...	,,
,,	,,	Poulscadden, Howth, ...	,,
,,	,,	Ballinacourty Pt., Dungarvan, ...	,,
Berenicea	megastoma, .	See with Spirorbis caperatus, .	,,
Orbiculites	antiquus, . .	Rahoran, Fivemiletown, . .	,,
Millepora	gracilis, . . .	Clonea, Dungarvan, ...	,,
,,	,,	Lisnapaste, Ballintra, . . .	,,
,,	,,	Ballinacourty, Dungarvan, .	,,
,,	interporosa, .	Malahide, Malahide, ...	,,
,,	,,	Mohill, Mohill, ...	,,
,,	,,	Lisnapaste, Ballintra, ...	Yellow Sandstone.
,,	oculata, . . .	Cregganore, Gort, ...	Carboniferous Slate.
,,	,,	Poulscadden, Howth, ...	,,
,,	rhombifera, .	Lisnapaste, Ballintra, . . .	,,
,,	,,	Poulscadden, Howth, . . .	Yellow Sandstone.
,,	similis, . . .	Cregganore, Gort, ...	Limestone of the Carboniferous Slate.
,,	,,	St. Doolough's, Dublin, . .	Carboniferous Slate.
,,	spicularis, . .	Poulscadden, Howth, . . .	,,
Gorgonia	assimilis, . .	Ballinacourty, Dungarvan, .	Yellow Sandstone and Arenaceous Limestone.
,,	zic-zac, . . .	Granard, Granard, ...	

Names of Fossils. Genera.	Species.	Localities and Post-Towns.	Subdivision
Jania	antiqua, . . .	St. John's Point, Dunkineely,	Carboniferous Slate.
"	bacillaria, . .	Lisnapaste, Ballintra, . . .	"
"	crassa, . . .	St. John's Point, Dunkineely,	Limestone of the Carboniferous Slate.
"	"	Lackagh, Drumquin,. . . .	Yellow Sandstone.
Vincularia	parallela, . .	Mohill, Mohill, ...	Carboniferous Slate.
Glanconome	bipinnata, . .	Ballinacourty, Dungarvan, .	"
"	"	Poulscadden, Howth,. . . .	"
"	pluma. . . .	Lisnapaste, Ballintra, . . .	"
"	"	Ballinacourty, Dungarvan, .	"
"	"	Poulscadden, Howth, . . .	"
"	"	Lackagh, Drumquin,. . . .	Yellow Sandstone.
Ptylopora	macropora,. .	Poulscadden, Howth, . . .	Carboniferous Slate.
"	pluma, . . .	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
"	"	Poulscadden, Howth, . . .	Carboniferous Slate.
"	"	Malahide, Malahide, ...	"
Fenestella	antiqua, . . .	Currens, Castle Island, . . .	"
"	"	Gurteenroe, Bantry, ...	"
"	"	Killingley, ...	"
"	"	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Blackball Head, Cork, . . .	Carboniferous Slate.
"	"	Malahide, Malahide, ...	"
"	carinata,. . .	Enagh, Tynan, ...	
"	"	Malahide, Malahide, ...	"
"	flabellata, . .	Bruckless, Dunkineely, . . .	Yellow Sandstone
"	formosa,. . .	Currens, Castle Island, . . .	Carboniferous Slate
"	"	Malahide, Malahide, ...	"
"	laxa, ...	Clonea Castle, Dungarvan, .	"
"	multiporata, .	Brickeen Bridge, Killarney, .	Yellow Sandstone.
"	nodulosa, . .	Poulscadden, Howth, . . .	Carboniferous Slate.
"	oculata, . . .	Ballinacourty, Dungarvan, .	"
"	plebeia, . . .	Killybrone, Killala, ...	Arenaceous Limestone.
"	regularis, . .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
"	reticularis, . .	Currens, Castle Island, . . .	"
"	spongites, . .	Poulscadden, Howth. . . .	"
"	tenuifila,. . .	Kilnamack, Clonmel,. . . .	"
"	"	Greaghs, Ballintra, ...	"
"	"	Bruckless, Dunkineely,. . .	Yellow Sandstone.
"	"	Poulscadden, Howth,. . . .	Carboniferous Slate.
"	"	Malahide, Malahide, ...	"
"	undulata, . .	Bruckless, Dunkineely, . . .	Yellow Sandstone.
"	"	Kilbride, Ballycastle,. . . .	Arenaceous Limestone.
"	"	Greaghs, Ballintra, ...	Carboniferous Slate.
"	"	Malahide, Malahide, ...	"
"	"	Poulscadden, Howth, . . .	"
Polypora	dendroides, .	Townparks, Killeshandra, . .	Yellow Sandstone.
"	"	Hook Head, Fethard, . . .	Limestone of the Carboniferous Slate.
Retepora	undata, . . .	Lisnapaste, Ballintra, . . .	Carboniferous Slate.
"	"	Mohill, Mohill, ...	"

Names of Fossils.		Localities and Post-Towns.	Subdivision.
Genera.	Species.		
PLANTS.			
LOWER CARBONIFEROUS PLANTS.			
Sternbergia	approximata,	Cultra, Hollywood, ...	Yellow Sandstone.
"	"	Golin, Cavan, ...	"
Sphenopteris	linearis, . .	Riv. Banagh, Drumcurren, Kesh, ...	"
Fucoides and	Ferns, . . .	Bunatrahir, Ballycastle, . .	"
Ferns and	Fucoides, . .	Kilcummin, Killala Bay, . .	Carboniferous Slate.
Ferns	"	Dromard, Draperstown, . .	Yellow Sandstone.
"	"	Fallagloon, Maghera, . . .	"
Stigmaria	ficoides, . . .	Mac Swyne's Bay, Dunkineely, and North coast of Mayo, .	"
Sigillaria and	Dictyophyllum	Do., do.	"
"	Ferns, . . .	Cork, Cork, ...	"
"	"	Blackball Head, Castletown,	"
"	"	Drummanmore, Armagh, . .	"
"	"	Camphire, Vale of the Bride,	Yellow Sandstone.
"	"	Janeville, Vale of the Bride,.	"
"	"	Bruckless Chapel, Dunkineely,	"
"	"	Bruckless, Dunkineely, . . .	"
"	"	Aighan Bridge, Dunkineely,	"
"	"	Brickeen Bridge, Killarney .	"
"	"	Clontarf, Dublin, ...	Carboniferous Slate.
"	"	Bleankillew, Drumod, . . .	"
"	"	Cultra, Hollywood, ...	Yellow Sandstone.
Cyclostigma	"	Kiltorcan, Ballyhale, . . .	"
Sphenopteris	Hibernica, .	" "	"
"	"	Tallow Bridge, ...	"
Lepidodendron	Griffithii, . .	" "	"
"	new, ...	Drumconny, Cloone, ...	Carboniferous Slate.

SECTION II.—DIVISION I.

The first member of the Second, or Limestone Group of the Series, is the Lower Carboniferous Limestone.

Names of Fossils.		Localities and Post-Towns.
Genera.	Species.	
MOLLUSCA.		
CEPHALOPODA.		
ORTHOCERATIDÆ.		
Orthoceras	attenuatum, ...	Rathgillen, Nobber.
"	cinctum, ...	"
"	cylindraceum, ...	Ballinacourty, Dungarvan.

Names of Fossils. Genera.	Names of Fossils. Species.	Localities and Post-Towns.
Orthoceras	cylindraceum, ...	Curkeen, Rush.
"	"	Tankardstown, Kildorrery.
"	"	Rathcline, Lanesborough.
"	ovale, ...	Rathgillen, Nobber.
"	"	Ardclogh, Kildare.
"	"	Ballinacourty, Dungarvan.
"	"	Annagh, Charleville.
"	pyramidale, ...	Millicent, Clane.
"	striatum, ...	Little Island, Cork.
"	"	Middleton, Cork.
Loxoceras	Breynii, ...	Millicent, Clane.
"	"	Little Island, Cork.
"	distans, ...	Kilmallock.
"	laterale, ...	Little Island, Cork.
"	"	"
"	"	Ardclogh, Rathcoole.
"	"	Millicent, Clane.
"	"	Carrigahorrig, Portumna.
"	"	Tirlecken, Ballymahon.
"	"	Ballinacourty, Dungarvan.
"	"	Cregg, Nobber.
Campyloceras	unguis, ...	Little Island, Cork.
Cycloceras	lævigatum, ...	Shrule, Ballymahon.
Poterioceras	fusiforme, ...	Millicent, Clane.
"	ventricosum, ...	"
Actinoceras	giganteum, ...	"
Cyrtoceras	tuberculatum, ...	Cork, Cork.
	NAUTILIDÆ.	
Goniatites	discus, ...	Cork, Cork.
"	excavatus, ...	Ballyduff, Dungarvan.
"	fasciculatus, ...	Millicent, Clane.
"	intercostalis, ...	Killyrean Upper, Emyvale.
"	latus, ...	Millicent, Clane.
"	Listeri, ...	Portumna, Galway.
"	"	Millicent, Clane.
"	"	Ballyduff, Dungarvan.
"	"	Howth, Howth.
"	"	Castlecree, Cork.
"	micronotus, ...	Ballinacourty, Dungarvan.
"	mutabilis, ...	Cregg, Nobber.
"	obtusus, ...	Ballyduff, Dungarvan.
"	"	Cork, Cork.
"	"	Millicent, Clane.
"	"	Cregg, Nobber.
"	ovatus, ...	Little Island, Cork.
"	"	Ballyduff, Dungarvan.
"	sphæroidalis, ...	" "
"	"	Nenagh, Tipperary.
"	"	Kilmallock.
"	striolatus, ...	Mullawornia, Ballymahon.

Names of Fossils.		Localities and Post-Towns.
Genera.	Species.	
Goniatites	truncatus,	Tankardstown, Kildorrery.
Discites	costellatus,	Millicent, Clane.
"	discors,	"
"	"	Blackrock, Cork.
"	latidorsatus,	Millicent, Clane.
"	planotergatus,	Cork, Cork.
"	subsulcatus,	Little Island, Cork.
"	"	Millicent, Clane.
"	sulcatus,	Little Island, Cork.
"	trochlea,	Cookstown, Cookstown.
Temnocheilus	biangulatus,	Ballinacourty, Dungarvan.
"	"	Middleton, Cork.
"	"	Tirlecken, Ballymahon.
"	"	Laracor, Trim.
"	"	Millicent, Clane.
"	cariniferus,	"
"	"	Tirlecken, Ballymahon.
"	"	Ardclogh, Kildare.
"	coronatus,	Little Island, Cork.
"	costalis,	Millicent, Clane.
"	crenatus,	Tirlecken, Shrule.
"	furcatus,	Castle Richard, Middleton.
"	multicarinatus,	Millicent, Clane.
"	"	Tankardstown, Kildorrery.
"	"	Tirlecken, Ballymahon.
"	"	Arclogh, Rathcoole.
"	"	Little Island, Cork.
"	"	Longford, Longford.
"	pinguis,	Kilmallock, Limerick.
"	"	Ballyduff, Dungarvan.
"	sulciferus,	Millicent, Clane.
"	"	Ballyduff, Dungarvan.
"	"	Ardclogh, Rathcoole.
"	tuberculatus,	Dungarvan, Waterford.
Nautilus	cyclostomus,	Little Island, Cork.
"	"	Middleton, Middleton
"	"	Ballybeg, Buttevant
"	dorsalis,	Little Island, Cork.
"	"	Kilcommock, Longford.
"	"	Millicent, Clane.
Bellerophon	apertus,	Ballyduff, Dungarvan.
"	"	Kiltullagh, Roscommon.
"	"	Annaghugh, Armagh.
"	"	Tankardstown, Kildorrery.
"	"	Carlingford, Carlingford.
"	"	Armagh, Armagh.
"	"	Drummanmore, Armagh.
"	"	Ardagh, Drumcondra.
"	cornu-arietis,	New Road, Armagh.
"	costatus,	Cookstown, Cookstown.
"	"	Carlingford, Carlingford.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Bellerophon	lævis, ...	Millicent, Clane.
”	obsoletus, ...	Millicent, Clane.
”	tangentialis, ...	Tirlecken, Ballymahon.
”	”	Carlingford, Carlingford.
”	”	Ardagh, Drumcondra.
”	tenuifascia, ...	Curkeen, Rush.
”	”	Ardagh, Drumcondra.
”	”	Millicent, Clane.
Euphemus	intersectus, ...	*Incerti loci.*
”	Urii, ...	Cookstown, Tyrone.
”	”	Cregg, Nobber.
GASTEROPODA.		
PECTINIBRANCHIATA.		
Macrocheilus	acutus, ...	Laracor, Trim.
”	”	Millicent, Clane.
”	curvilineus, ...	Millicent, Clane.
”	imbricatus, ...	Millicent, Clane.
”	parallelus, ...	Armagh, Armagh.
”	rectilineus, ...	Little Island, Cork.
”	”	Drumlattery, Skerries.
Loxonema	brevis, ...	Toberory, Tulsk.
”	constricta, ...	Rathmoyle House, Roscommon.
”	”	Millicent, Clane.
”	impendens, ...	Chicken Hill, Kilmallock.
”	polygyra, ...	Curkeen, Rush.
”	sulculosa, ...	Millicent, Clane.
”	”	Tankardstown, Kildorrery.
”	tumida, ...	Tirlecken, Ballymahon.
Turritella	megaspira, ...	Millicent, Clane.
”	suturalis, ...	Carrigahorrig, Portumna.
”	”	Cookstown, Tyrone.
”	”	Horath, Moynalty.
”	teniustria, ...	Oldtown, Dublin.
”	”	Tymore Todd, Augher.
”	”	Laracor, Trim.
”	”	Tirlecken, Ballymahon.
Naticopsis	canaliculata, ...	Ring, Enniskillen.
”	dubia, ...	Carrigaline, Cork.
”	elongata, ...	Millicent, Clane.
”	”	Kilmore, Armagh.
”	”	Kiltullagh, Roscommon.
”	Neritoides, ...	Tullyoran, Mohill.
”	Phillipsii, ...	Kilcommock, Longford.
”	”	Ardclogh, Rathcoole.
”	”	Ballyduff, Dungarvan.
”	”	Ballinacourty, Dungarvan.
”	”	Millicent, Clane.
”	”	Lane, Skerries.

Names of Fossils.		Localities and Post-Towns.
Genera.	Species.	
Naticopsis	plicistria, ...	Armagh, Armagh.
"	"	Cookstown, Tyrone.
"	"	College Hall, Tynan.
Euomphalus	acutus, ...	Millicent, Clane.
"	"	Howth, Howth.
"	"	Ballykea, Skerries.
"	"	Little Island, Cork.
"	"	Ardagh, Drumcondra.
"	æqualis, ...	Curkeen, Rush.
"	"	Ballykea, Skerries.
"	anguis, ...	Chicken Hill, Kilmallock.
"	calyx, ...	Millicent, Clane.
"	"	Tankardstown, Kildorrery.
"	cristatus, ...	Strokestown, Roscommon.
"	crotalostomus, ...	Carrickreagh, Enniskillen.
"	"	Rathmoyle House.
"	"	Drum, Ederny.
"	neglectus, ...	Millicent, Clane.
"	pentangulatus, ...	Millicent, Clane.
"	"	Tirlecken, Ballymahon.
"	"	Little Island, Cork.
"	"	Carrigahorrig, Portumna.
"	"	Ballykea, Skerries.
"	"	Tankardstown, Kildorrery.
"	"	Ardclogh.
"	"	Ardclogh, Rathcoole.
"	"	Millicent, Clane.
"	pileopsideus, ...	Ardagh, Drumcondra.
"	"	Howth, Howth.
"	rotundatus, ...	Cookstown, Cookstown.
"	"	New Road, Armagh.
"	"	Ardagh, Drumcondra.
"	"	Mullaghfin, Duleek.
"	"	Little Island, Cork.
"	tabulatus, ...	Moymore, Tulla.
"	"	Little Island, Cork.
"	"	Mulnahunch, Dungannon.
"	"	Tirlecken, Shrule.
Platyschisma	Cirroides, ...	College Hall, Tynan.
"	Helicoides, ...	Cookstown, Cookstown.
"	"	Curkeen, Rush.
"	"	Millicent, Clane.
"	Jamesii, ...	Donaghrisk, Cookstown.
"	zonites, ...	Cork.
Pleurotomaria	carinata, ...	Cookstown, Tyrone.
"	concentrica, ...	Clare, Cookstown.
"	"	Milverton, Skerries.
"	decussata, ...	Millicent, Clane.
"	filosa, ...	Millicent, Clane.
"	Griffithii, ...	Ardclogh, Rathcoole.
"	"	Millicent, Clane.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Pleurotomaria	Hainesii, ...	Little Island, Cork.
"	lenticula, ...	Little Island, Cork.
"	multicarinata, ...	Millicent, Clane.
Elenchus	subulatus, ...	Armagh, Armagh.
SCUTIBRANCHIATA AND CYCLOBRANCHIATA.		
Trochella	prisca, ...	Millicent, Clane.
Acroculia	angustata, ...	Clare, Cookstown.
"	canaliculata, ...	Toberory, Tulsk.
"	carinata,.	Millicent, Clane.
"	triloba, ...	Kilmallock.
"	tubifer, ...	Hook Head, Fethard.
"	vetusta, ...	Little Island, Cork.
"	"	Millicent, Clane.
Patella	mucronata,.	Cookstown, Tyrone.
"	scutiformis, ...	New Canal, Tralee.
"	sinuosa, ...	Millicent, Clane.
Siphonaria	Konincki, ...	Ballymacelligut, Tralee.
Umbrella	lævigata, ...	Millicent, Clane.
Dentalium	inornatum,.	Cookstown, Cookstown.
DITHYRA.		
MACROTRACHIA.		
Sanguinolites	arcuatus, ...	Millicent, Clane.
"	contortus, ...	Kilmallock.
"	sulcatus,.	Drummanmore, Armagh.
"	"	Cookstown.
"	tumidus, ...	Millicent, Clane.
"	"	Armagh, Armagh.
Edmondia ?	compressa, ...	Cork.
Lutraria	prisca, ...	Millicent, Clane.
Mactra	incrassata, ...	Kilmallock.
Psammobia	decussata, ...	Little Island, Cork.
Amphidesma	subtruncatum, ...	Millicent, Clane.
Corbis	cancellata, ...	Carrigaline, Cork.
Cyprina	Egertoni, ...	Millicent, Clane.
"	"	Kilmallock.
Donax	primigenius, ...	Cookstown, Cookstown.
Cardium	orbiculare, ...	Little Island, Cork.
"	"	Leek, Monaghan.
Cardiomorpha	axiniformis, ...	Millicent, Clane.
"	corrugata, ...	Millicent, Clane.
"	oblonga,.	Moore, Roscommon.
"	"	Little Island, Cork.
"	"	Millicent, Clane.
"	ventricosa,.	Cork.
Pleurorhynchus	Hibernicus, ...	Millicent, Clane.

Names of Fossils.		Localities and Post-Towns.
Genera.	Species.	
Pleurorhynchus	Hibernicus, ...	Middleton, Cork.
,,	,,	Tankardstown, Kildorrery.
,,	,,	Castle Island, Castle Island.
,,	inflatus, ...	Carrickboy, Longford.
,,	minax, ...	Ballykea, Skerries.
,,	,,	Millicent, Clane.
,,	,,	Ballyduff, Dungarvan.
,,	trigonalis, ...	Clonturk, Carrickmacross.
Cypricardia	cuneata, ...	Balsitric, Nobber.
,,	cylindrica, ...	Millicent, Clane.
Leptodomus	fragilis, ...	*Incerti loci.*
,,	senilis, ...	Millicent, Clane.
,,	,,	Ardagh, Drumcondra.
Venerupis	cingulatus, ...	Howth, Howth.
,,	obsoletus, ...	Millicent, Clane.
,,	scalaris, ...	Millicent, Clane.
	ATRACHIA.	
Nucula	rectangularis, ...	Cookstown, Cookstown.
Arca	fimbriata, ...	Ballyduff, Dungarvan.
Cucullæa	arguta, ...	Bantyre, Cork.
,,	tenuistria, ...	Cregg, Nobber.
,,	,,	Rathgillen, Nobber.
Byssoarca	obtusa, ...	Millicent, Clane.
,,	reticulata, ...	Millicent, Clane.
Modiola	patula, ...	Blackrock, Cork.
Lithodomus	dactyloides, ...	Millicent, Clane.
Mytilus	Flemingi, ...	Millicent, Clane.
Inoceramus	lævissimus, ...	Cork, Cork.
,,	orbicularis, ...	Millicent, Clane.
,,	pernoides, ...	Millicent, Clane.
,,	vetustus, ...	Ardagh, Drumcondra.
Meleagrina	lævigata, ...	Ardagh, Drumcondra.
,,	,,	Millicent, Clane.
,,	,,	Curkeen, Rush.
,,	,,	Howth, Howth.
,,	pulchella, ...	Millicent, Clane.
,,	quadrata, ...	Millicent, Clane.
,,	radiata, ...	Ardagh, Drumcondra.
Pteronites	latus, ...	Millicent, Clane.
Avicula	lævigata, ...	Millicent, Clane.
,,	laminosa, ...	Millicent, Clane.
,,	,,	Howth, Howth.
,,	,,	Ardagh, Drumcondra.
,,	lunulata, ...	Howth, Howth.
,,	,,	Salmon, Balbriggan.
,,	,,	Millicent, Clane.
,,	recta, ...	Millicent, Clane.
Pinna	flabelliformis, ...	Cookstown, Cookstown.
Anomia	antiqua, ...	Poulscadden, Howth.

Names of Fossils. Genera.	Species.	Localities and Post-Towns
Lima	alternata,	Ardagh, Drumcondra.
"	lævigata,	Millicent, Clane.
"	prisca,	Ardagh, Drumcondra.
Pecten	arenosus,	Millicent, Clane.
"	"	Howth, Howth.
"	clathratus,	Little Island, Cork.
"	cœlatus,	Red Barn, Armagh.
"	"	Cookstown, Tyrone.
"	concentrico-striatus,	Millicent, Clane.
"	"	Howth, Dublin.
"	deornatus,	Little Island, Cork.
"	dissimilis,	Millicent, Clane.
"	"	Ballyduff, Dungarvan.
"	ellipticus,	Ballyduff, Dungarvan.
"	"	Millicent, Clane.
"	"	Little Island, Cork.
"	"	Tullyard, Armagh.
"	"	Howth, Dublin.
"	elongatus,	Millicent, Clane.
"	fallax,	Kilmore, Cavan.
"	"	Millicent, Clane.
"	"	Little Island, Cork.
"	"	Ballyduff, Dungarvan.
"	filatus,	Millicent, Clane.
"	flexuosus,	New Road, Armagh.
"	"	Tonyshanderry, Emyvale.
"	Forbesii,	Millicent, Clane.
"	gibbosus,	Ballyduff, Dungarvan.
"	"	Howth.
"	granosus,	Millicent, Clane.
"	"	Little Island, Cork.
"	"	Howth, Dublin.
"	hians,	Millicent, Clane.
"	intercostatus,	Little Island, Cork.
"	mundus,	Flemingstown, Balbriggan.
"	Murchisoni,	Tankardstown, Kildorrery.
"	"	Cregg, Nobber.
"	ovatus,	Ardagh, Drumcondra.
"	planicostatus,	Little Island, Cork.
"	plicatus,	Ballyduff, Dungarvan.
"	"	Mullawornia, Ballymahon.
"	Sedgwickii,	Little Island, Cork.
"	semistriatus,	Little Island, Cork.
"	"	Ardagh, Drumcondra.
"	Sowerbii,	Howth, Howth.
"	"	Millicent, Clane.
"	"	Ballyduff, Dungarvan.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
	BRACHIOPODA.	
	ATHYRIDÆ.	
Crania	vesiculosa, ...	Millicent, Clane.
Calceola	sandalina, ...	Ballyduff, Dungarvan.
Producta	aculeata, ...	Howth, Howth.
,,	,,	Mullawornia, Ballymahon.
,,	antiquata, ...	Hook Head, Fethard.
,,	,,	Ardclogh, Rathcoole.
,,	,,	Millicent, Clane.
,,	,,	Cornacarrow, Enniskillen.
,,	aurita, ...	Donaghrisk, Cookstown.
,,	,,	Cookstown, Tyrone.
,,	concinna, ...	Little Island, Cork.
,,	,,	Boston, Rathangan.
,,	,,	Cookstown, Tyrone.
,,	,,	Tullyoran, Mohill.
,,	,,	Boyle, Roscommon.
,,	corrugata, ...	Salmon, Man-of-War, Balbriggan.
,,	,,	Milverton, Skerries.
,,	,,	Kiltullagh, Castlereagh.
,,	Edelburgensis, ...	Ardagh, Drumcondra.
,,	,,	Cregg, Nobber.
,,	,,	Ballykea, Skerries.
,,	elegans, ...	Cornacarrow, Enniskillen.
,,	,,	Cookstown, Tyrone.
,,	,,	Killukin, Carrick-on-Shannon.
,,	,,	Armagh, Armagh.
,,	fimbriata, ...	Ardagh, Drumcondra.
,,	,,	Cookstown, Tyrone.
,,	,,	Mullawornia, Ballymahon.
,,	,,	Little Island, Cork.
,,	flexistria, ...	Millicent, Clane.
,,	,,	St. Doolough's, Dublin.
,,	fragaria, ...	Little Island, Cork.
,,	,,	Ardclogh, Rathcoole.
,,	,,	Howth, Howth.
,,	gigantea, ...	Kiltullagh, Roscommon.
,,	granulosa, ...	Millicent, Clane.
,,	,,	Killukin, Carrick-on-Shannon.
,,	hemisphaerica, ...	Dundonagh.
,,	,,	Kilmore, Armagh.
,,	,,	Little Island, Cork.
,,	,,	Ballyhoe Lake, Drumcondra.
,,	intermedia, ...	*See* Inoceramus orbicularis.
,,	laciniata, ...	Millicent, Clane.
,,	,,	Ballyduff, Dungarvan.
,,	latissima, ...	Tullyoran, Mohill.
,,	laxispina, ...	Ardagh, Drumcondra.

Names of Fossils.		Localities and Post-Towns.
Genera.	Species.	
Producta	laxispina, ...	Salmon, Man-of-War, Balbriggan.
"	lirata, ...	Ballyduff, Dungarvan.
"	"	Howth, Howth.
"	margaritacea, ...	Howth, Howth.
"	"	Millicent, Clane.
"	Martini, ...	Rathgillen, Nobber.
"	"	Lisardrea, Boyle.
"	"	Cookstown, Tyrone.
"	"	Ardagh, Dumcondra.
"	"	Mullaghfin, Duleek.
"	maxima, ...	Cregg, Nobber.
"	mesoloba, ...	Millicent, Clane.
"	"	Ardagh, Drumcondra.
"	"	Laracor, Trim.
"	"	Little Island, Cork.
"	"	Tankardstown, Kildorrery.
"	muricata, ...	Moore, Ballinasloe.
"	ovalis, ...	Carrigaline, Cork.
"	pectinoides, ...	Ballyduff, Dungarvan.
"	"	Ardclogh, Rathcoole.
"	"	Cregg, Nobber.
"	"	Millicent, Clane.
"	"	Salmon, Man-of-War, Balbriggan.
"	"	Rathgillen, Nobber.
"	punctata, ...	Drummanmore, Armagh.
"	pugilis, ...	Rathcline, Longford.
"	"	Boyle, Roscommon.
"	punctata, ...	Little Island, Cork.
"	"	Rathmoyle House, Roscommon.
"	"	Salmon, Man-of-War, Balbriggan.
"	"	Rathgillen, Nobber.
"	pustulosa, ...	Tankardstown, Kildorrery.
"	"	Ardagh, Drumcondra.
"	"	Milverton, Skerries.
"	quincuncialis, ...	Little Island, Cork.
"	"	Rathcline, Longford.
"	"	Cornacarrow, Enniskillen.
"	"	Tullyoran, Mohill.
"	rugata, ...	Howth, Howth.
"	"	Ballyduff, Dungarvan.
"	"	Millicent, Clane.
"	scabricula, ...	Drumdoe, Boyle.
"	"	Kiltullagh, Castlereagh.
"	"	St. Doolough's, Dublin.
"	"	Cornacarrow, Enniskillen.
"	Scotica, ...	Little Island, Cork.
"	"	Cookstown, Tyrone.
"	"	Dundonagh.
"	"	Monaghan, Monaghan.
"	"	Mullaghliss, Monaghan.
"	setosa, ...	Rathcline, Lanesborough.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Producta	setosa, ...	Cookstown, Tyrone.
"	"	Millicent, Clane.
"	"	Little Island, Cork.
"	spinosa, ...	Howth, Howth.
"	"	Boyle, Roscommon.
"	"	Grangemore, Boyle.
"	striata, ...	Ardagh, Drumcondra.
"	sublævis, ...	Ardagh, Drumcondra.
"	sulcata, ...	Cregg, Nobber.
"	"	Ardagh, Drumcondra.
"	"	Ballykea, Skerries.
"	"	Rathgillen, Nobber.
"	"	Armagh, Armagh.
"	"	Tankardstown, Kildorrery.
"	tortilis, ...	Tullanaguiggy, Fermanagh.
Leptagonia	analoga, ...	Cornacarrow, Enniskillen.
"	"	Killukin, Carrick-on-Shannon.
"	"	Middleton, Cork.
"	"	Rathgillen, Nobber.
"	"	Millicent, Clane.
"	multirugata, ...	Millicent, Clane.
"	plicatilis, ...	Salmon, Man-of-War, Balbriggan.
"	plicatilis, ...	Ardagh, Drumcondra.
"	"	Rathcline, Longford.
"	"	Little Island, Cork.
Leptæna,	" ?	Millicent, Clane.
"	Hardrensis, ...	Ballyduff, Dungarvan.
"	"	Lisardrea, Boyle.
"	"	Termon, Boyle.
"	serrata, ...	Millicent, Clane.
"	volva, ...	Millicent, Clane.
	DELTHYRIDÆ.	
Orthis	connivens, ...	Little Island, Cork.
"	crenistria, ...	Ardagh, Drumcondra.
"	"	Longford, Longford.
"	"	Carrigaline, Cork.
"	"	Tankardstown, Kildorrery.
"	"	Millicent, Clane.
"	divaricata, ...	Millicent, Clane.
"	"	Ballyduff, Dungarvan.
"	filiaria, ...	Grangemore, Boyle.
"	"	Lisardrea, Boyle.
"	"	Howth, Howth.
"	gibbera, ...	Cornacarrow, Enniskillen.
"	Kellii, ...	Annaghilla, Ballygawley.
"	"	Monaghan, Monaghan.
"	longisulcata, ...	Ballyduff, Dungarvan.
"	papilionacea, ...	Termon, Boyle.
"	"	Cregg, Nobber.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Orthis	papilionacea, ...	Ardclogh, Rathcoole.
"	"	Millicent, Clane.
"	radialis, ...	Ardagh, Drumcondra.
"	resupinata, ...	Cornacarrow, Enniskillen.
"	"	Little Island, Cork.
"	"	Millicent, Clane.
"	tuberculata, ...	Millicent, Clane.
Spirifera	attenuata, ...	Cornacarrow, Enniskillen.
"	"	Millicent, Clane.
"	"	Moore, Roscommon.
"	"	Cloghran, Maryborough.
"	"	Cregg, Nobber.
"	bisulcata, ...	Millicent, Clane.
"	"	Rathcline, Longford.
"	calcarata, ...	Little Island, Cork.
"	choristites, ...	Little Island, Cork.
"	crispa, ...	Cregg, Nobber.
"	decemcostata, ...	Millicent, Clane.
"	disjuncta, ...	Little Island, Cork.
"	gigantea, ...	Carrigaline, Cork.
"	"	Tullyoran, Mohill.
"	octoplicata, ...	Cregg, Nobber.
"	ornithorhyncha, . . .	Millicent, Clane.
"	ostiolata, ...	Clonturk, Carrickmacross.
"	princeps, ...	Millicent, Clane.
"	quinqueloba, ...	Ardagh, Drumcondra.
"	rhomboidea, ...	Tankardstown, Kildorrery.
"	"	Rathgillen, Nobber.
"	"	Ardclogh, Rathcoole.
"	rotundata, ...	Cornacarrow, Enniskillen.
"	"	Millicent, Clane.
"	"	Boyle, Roscommon.
"	"	Little Island, Cork.
"	"	Ardclogh, Rathcoole.
"	speciosa, ...	Howth, Howth.
"	striata, ...	Tankardstown, Kildorrery.
"	"	Mullaghfin, Duleek.
"	trigonalis, ...	Ardagh, Drumcondra.
"	"	Salmon, Man-of-War, Balbriggan.
"	"	Mullaghfin, Duleek.
"	"	Cregg, Nobber.
"	Urii, ...	Howth, Howth.
Cyrtia	cuspidata, ...	Millicent, Clane.
"	"	Little Island, Cork.
"	"	Ballyduff, Dungarvan.
"	distans, ...	Cookstown, Tyrone.
"	"	Ballinacourty, Dungarvan.
"	"	Howth, Howth.
"	"	Millicent, Clane.
"	dorsata, ...	Cork.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Cyrtia	linguifera, ...	Rathmoyle House, Roscommon.
"	"	Rathcline, Longford.
"	"	Millicent, Clane.
"	senilis, ...	Armagh, Armagh.
"	"	Cookstown, Tyrone.
"	semicircularis, ...	Slane, Co. Meath.
"	simplex,.	Blackrock, Cork.
Martinia	decora, ...	Mullaghfin, Duleek.
"	elliptica,.	Carrigaline, Cork.
"	"	Millicent, Clane.
"	"	Ardagh, Drumcondra.
"	glabra, ...	Millicent, Clane.
"	"	Little Island, Cork.
"	"	Cornacarrow, Enniskillen.
"	oblata, ...	Armagh, Armagh.
"	"	Milverton, Skerries.
"	"	Mullaghfin, Duleek.
"	"	Ardagh, Drumcondra.
"	"	Cornacarrow, Enniskillen.
"	"	Cregg, Nobber.
"	"	Rathcline, Longford.
"	obtusa, ...	Tullyoran, Mohill.
"	"	Rathcline, Longford.
"	"	Little Island, Cork.
"	"	Howth, Howth.
"	plebeia, ...	Millicent, Clane.
"	"	Ardagh, Drumcondra.
"	"	Little Island, Cork.
"	"	Mullaghfin, Duleek.
"	"	Cookstown, Tyrone.
"	"	Armagh, Armagh.
"	rhomboidalis, ...	Cork.
"	symmetrica, ...	Mullaghfin, Duleek.
Reticularia	imbricata, ...	Little Island, Cork.
"	"	Ardagh, Drumcondra.
"	"	Rathmoyle House, Roscommon.
"	"	Mullawornia, Ballymahon.
"	lineata, ...	Curkeen, Rush.
"	"	Little Island, Cork.
"	"	Tankardstown, Kildorrery.
"	reticulata, ...	Armagh, Armagh.
Brachythyris	duplicicosta, ...	Armagh, Armagh.
"	"	Mullaghfin, Duleek.
"	exarata, ...	Rathcline, Longford.
"	integricosta, ...	Armagh, Armagh.
"	ovalis, ...	Ballyduff, Dungarvan.
"	pinguis, ...	Rathcline, Longford.
"	"	Rush, Rush.
"	"	Millicent, Clane.
"	"	Tirlecken, Ballymahon.
"	"	St. Doolough's.

Names of Fossils		Localities and Post-Towns
Genera.	Species.	
Brachythyris	planicostata, ...	Mullaghfin, Duleek.
,,	,,	Milverton, Skerries.
Athyris	decussata, ...	Howth, Howth.
,,	expansa, ...	Ardagh, Drumcondra.
,,	,,	Armagh, Armagh.
,,	,,	Milverton, Skerries.
,,	,,	Drumdoe, Boyle.
,,	fimbriata, ...	Boyle, Roscommon.
,,	glabristria, ...	Little Island, Cork.
,,	,,	Laghy, Donegal.
,,	,,	Clare, Cookstown.
,,	,,	Millicent, Clane.
,,	,,	Rathcline, Longford.
,,	globularis, ...	Ardagh, Drumcondra.
,,	planosulcata, ...	Rathgillen, Nobber.
,,	squamosa, ...	Moore, Roscommon.
,,	,,	Ardagh, Drumcondra.
,,	,,	Hook Head, Fethard.
Actinoconchus	paradoxus, ...	Knockagh, Dundalk.
,,	,,	Little Island, Cork.
,,	,,	Mullawornia, Ballymahon.
,,	,,	Millicent, Clane.
Terebratulidæ.		
Atrypa	acuminata, ...	Salmon, Man-of-War, Balbriggan.
,,	,,	Kiltullagh, Roscommon.
,,	,,	Little Island, Cork.
,,	anisodonta, ...	Cork.
,,	bifera, ...	Mullaghfin, Duleek.
,,	,,	Millicent, Clane.
,,	cordiformis, ...	Little Island, Cork.
,,	,,	Millicent, Clane.
,,	excavata, ...	Ardagh, Drumcondra.
,,	ferita, ...	Millicent, Clane.
,,	hastata, ...	Rathmoyle House, Roscommon.
,,	,,	Millicent, Clane.
,,	,,	Armagh, Armagh.
,,	isorhyncha, ...	Cookstown, Tyrone.
,,	,,	*Incerti loci.*
,,	lachryma, ...	Howth, Dublin.
,,	laticliva, ...	Cookstown, Tyrone.
,,	obtusa, ?	Milverton, Skerries.
,,	platyloba, ...	Little Island, Cork.
,,	pleurodon, ...	Cregg, Nobber.
,,	pugnus	Ardagh, Drumcondra.
,,	,,	Mullaghfin, Duleek.
,,	,,	Millicent, Clane.
,,	,,	Ardclogh, Rathcoole.
,,	,,	Rathcline, Longford.
,,	radialis, ...	Cookstown, Tyrone.

Names of Fossils. Genera	Names of Fossils. Species.	Localities and Post-Towns.
Atrypa	radialis,	Fymore Todd, Augher.
"	reniformis,	Millicent, Clane.
"	sacculus,	Millicent, Clane.
"	"	Ardagh, Drumcondra.
"	"	Howth.
"	"	Little Island, Cork.
"	sulcirostris,	Howth.
"	"	Drumdoe, Boyle.
"	"	Cregg, Nobber.
"	triangularis,	Little Island, Cork.
"	ventilabrum,	Howth.
"	"	Ardagh, Drumcondra.
"	virgo,	Cookstown, Cookstown.
Seminula	pentahedra,	Millicent, Clane.
"	pisum,	Howth, Howth.
"	"	Laracor, Trim.
"	rhomboidea,	Howth.
	CRUSTACEA.	
Griffithides	globiceps,	Millicent, Clane.
"	"	*Incerti loci.*
"	obsoletus,	Rush, Rush.
Phillipsia	cœlata,	No loc.
" ?	discors, ?	Millicent, Clane.
"	gemmulifera,	Millicent, Clane.
"	"	Howth.
"	Jonesii,	Ballygasey, Loughgall.
"	Kellii,	Cookstown, Tyrone.
"	mucronata,	Kildress, Cookstown.
"	quadriserialis,	Millicent, Clane.
"	truncatula,	Howth.
Dithyrocaris	tenuistriatus,	Little Island, Cork.
Entomoconchus	Scouleri,	Little Island, Cork.
"	"	Millicent, Clane.
Cythere	inflata,	Ballyduff, Dungarvan.
"	"	Laracor, Trim.
	ANNELIDA.	
Sabella	antiqua,	Kildress, Cookstown.
	ECHINODERMATA.	
Palæchinus	ellipticus,	Millicent, Clane.
Echinocrinus	vetustus,	Ardagh, Drumcondra.
Platycrinus	rugosus,	Ardclogh, Kildare.
"	"	Howth, Howth.
"	"	Derryvullan, Enniskillen.
Poteriocrinus	impressus,	Millicent, Clane.
Cyathocrinus	pinnatus,	Rinniskiddy, Cork.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Rhodocrinus	abnormis, ...	Millicent, Clane.
Actinocrinus	amphora, ...	Derryvullan, Enniskillen.
"	polydactylus, ...	Millicent, Clane.
"	triacontadactylus, . . .	Ardclogh, Rathcoole.
"	"	Cregg, Nobber.
"	"	Armagh, Armagh.
"	"	Millicent, Clane.
	ZOOPHYTA.	
Amplexus	Sowerbii, ...	Moore, Roscommon.
"	"	Millicent, Clane.
"	"	Cornacarrow, Enniskillen.
"	"	Little Island, Cork.
"	tortuosus, ...	Ballyduff, Dungarvan.
"	"	Mullawornia, Ballymahon.
Turbinolia	expansa, ...	Little Island, Cork.
"	fungites, ...	Termon, Boyle.
"	"	Lough Erne, Fermanagh.
"	"	Ardagh, Drumcondra.
"	"	Little Island, Cork.
"	"	Cleene, Roscommon.
Siphonophyllia	cylindrica, ...	Carlingford, Carlingford.
Astræa	aranea, ...	Magheramore, Tobercurry.
"	crenularis, ...	Armagh, Armagh.
"	"	Tumpher, Stewartstown.
"	"	Cookstown, Tyrone.
Lithodendron	affine, ...	*Incerti loci.*
"	"	Kiltullagh, Castlereagh.
"	"	Cregg Nobber.
"	cæspitosum, ...	*Incerti loci.*
"	"	Cookstown, Tyrone.
"	irregulare, ...	Rathcline, Lanesborough.
"	pauciradialis, ...	Magheramore, Tobercurry.
"	sociale, ...	Roscommon, Roscommon.
"	"	Ballygasey, Loughgall.
Lithostrotion	striatum, ...	Rathcline, Lanesborough.
"	"	Cookstown, Tyrone.
"	"	Tullyard, Armagh.
Syringopora	catenata, ...	*Incerti loci.*
"	geniculata, ...	Armagh, Armagh.
"	"	Malahide, Malahide.
"	laxa, ...	Kilmore, Armagh.
Aulopora	gigas, ...	Cornacarrow, Enniskillen.
Favosites	capillaris, ...	Armagh, Armagh.
"	Gothlandica, ...	St. John's Point, Dunkineely.
" (?)	megastoma ?	Termon, Boyle.
"	"	Howth.
"	"	Lismore, Aughnacloy.
" (?)	parasitica ?	Boyle, Roscommon.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Favosites	septosus, ...	New Road, Armagh.
"	spongites, ...	Grangemore, Roscommon.
"	"	Cregg, Nobber.
"	"	Killukin, Carrick-on-Shannon.
"	tenuisepta, ...	Cleene, Roscommon.
Stromatopora	polymorpha, ...	Ballyduff, Dungarvan.
"	subtilis, ...	Curkeen, Rush.
Verticillopora	dubia, ...	Cookstown, Tyrone.
Gorgonia	Lonsdaleiana, ...	Laracor, Trim.
Jania	crassa, ...	St. John's Point, Dunkineely.
Vincularia	dichotoma, ...	Millicent, Clane.
"	"	Howth.
Glauconome	gracilis, ...	Little Island, Cork.
"	grandis, ...	Meelick Chapel, Co. Clare.
"	pluma, ...	Laracor, Trim.
Fenestella	antiqua, ...	Ballinacourty, Dungarvan.
"	crassa, ...	Ballinacourty, Dungarvan.
"	"	Millicent, Clane.
"	flabellata, ...	*See* Ichthyorachis, Newenhami.
"	hemispherica, ...	Little Island, Cork.
"	membranacea, ...	Kilcommock, Longford.
"	"	Millicent, Clane.
"	"	Howth, Howth.
"	Morrisii, ...	Little Island, Cork.
"	plebeia, ...	Little Island, Cork.
"	reticularis, ...	Howth, Howth.
"	tenuifila, ...	Tankardstown, Kildorrery.
"	"	Howth, Howth.
Hemitrypa	Hibernica, ...	Little Island, Cork.
Ichthyorachis	Newenhami, ...	Kilmallock, Co. Limerick.
Retepora	prisca, ...	Ballinacourty, Dungarvan.
"	"	St. Doolough's, Dublin.
"	undata, ...	Ballinacourty, Dungarvan.
"	"	Millicent, Clane.
"	"	Howth, Howth.
Fenestella	undulata, ...	Howth, Howth.

Section II.—Division II.

The Second Division of the Limestone Group consists of the Middle Limestone, or Calp Series.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
MOLLUSCA.		
Cephalopoda.		
ORTHOCERATIDÆ.		
Orthoceras	attenuatum, ...	Bundoran, Bundoran.
„	cinctum, ...	Rush, Rush.
„	mucronatum, ...	*Incerti loci.*
Loxoceras	laterale, ...	Bundoran, Bundoran.
Cyrtoceras	tuberculatum, ...	Bundoran.
Nautilidæ.		
Goniatites	Gibsoni, ...	Paget Priory, Maynooth.
Gasteropoda.		
PECTINIBRANCHIA.		
Loxonema	sulculosa, ...	Bundoran, Bundoran.
Lacuna	antiqua, ...	Kilcummin, Killala.
Euomphalus	calyx, ...	Finner, Bundoran.
„	crotalostomus, ...	Finner, Bundoran.
„	pentangulatus, ...	Bundoran, Bundoran.
SCUTIBRANCHIA AND CYCLOBRANCHIA.		
Dirinus	Bucklandi, ...	Manorhamilton, Manorhamilton.
Patella	sinuosa, ...	Bundoran, Bundoran.
Dithyra.		
MACROTRACHIA.		
Sanguinolites	angustatus, ...	Ballintrillick, Bundoran.
„	curtus, ...	Manorhamilton, Manorhamilton.
„	Iridinoides, ...	Manorhamilton, Manorhamilton.
„	„	Ballintrillick, Bundoran.
„	plicatus, ...	Ballintrillick, Bundoran.
Lucina	antiqua, ...	Ballintrillick, Bundoran.
Ungulina	antiqua, ...	Bundoran, Bundoran.
Amphidesma	subtruncatum, ...	Bundoran, Bundoran.
Pleurorhynchus	giganteus, ...	Finner, Bundoran.
„	„	Abbeybay, Ballyshannon.
„	minax, ...	Bundoran, Bundoran.
„	„	Finner, Bundoran.
„	nodulosus, ...	Drumod, Mohill.
Cypricardia	subtruncata, ...	Ballintrillick, Bundoran.
Dolabra	rectangularis, ...	Bundoran, Bundoran.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
	Atrachia.	
Nucula	attenuata,	Ballintrillick, Bundoran.
"	cylindrica,	Bundoran, Bundoran.
"	Phillipsii,	Ballintrillick, Bundoran.
Byssoarca	clathrata,	Finner, Bundoran.
"	reticulata,	Bundoran, Bundoran.
"	semicostata,	Manorhamilton, Manorhamilton.
Posidonia	Becheri,	Cruisetown, Nobber.
"	"	Courtlough, Balbriggan.
"	"	Rush, Rush.
"	costata,	Rush, Rush.
"	lateralis,	Rush, Rush.
"	"	Rush, Rush.
"	membranacea,	Baldongan, Skerries.
"	"	Rush, Rush.
"	"	Walterstown, Navan.
"	similis,	Courtlough, Balbriggan.
"	tuberculata,	Rush, Rush.
Pteronites	sulcatus,	Manorhamilton, Manorhamilton.
Avicula	flabellulum,	Bundoran, Bundoran.
"	laminosa,	Bundoran, Bundoran.
"	squamosa,	Ballintrillick, Bundoran.
Pinna	inæquicostata,	*Incerti loci.*
Lima	obliqua,	Ballintrillick, Bundoran.
"	semisulcata,	Manorhamilton, Manorhamilton.
Pecten	cingendus,	Abbeybay, Ballyshannon.
"	depilis,	Ballintrillick, Bundoran.
"	ellipticus,	Ballintrillick, Bundoran.
"	granulosus,	Ballintrillick; Bundoran.
"	interstitialis,	Ballintrillick, Bundoran.
"	megalotis,	Bundoran, Bundoran.
"	"	Manorhamilton, Manorhamilton.
"	plano-clathratus,	Bundoran, Bundoran.
"	plicatus,	Rush, Rush.
"	"	Ballintrillick, Bundoran.
"	polytrichus,	Ballintrillick, Bundoran.
"	sclerotis,	Bundoran, Bundoran.
"	segregatus,	Manorhamilton, Manorhamilton.
"	Sowerbii,	Ballintrillick, Bundoran.
"	"	Bundoran, Bundoran.
"	tabulatus,	Ballintrillick, Bundoran.
"	variabilis,	Bundoran, Bundoran.
	BRACHIOPODA.	
	ORBICULIDÆ.	
Orbicula	nitida,	Bundoran, Bundoran.
Producta	aculeata,	Rush, Rush.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Producta	antiquata, ...	Manorhamilton, Manorhamilton.
"	concinna, ...	Rush, Rush.
"	"	Abbeybay, Ballyshannon.
"	"	Finner, Bundoran.
"	corrugata, ...	Ballintrillick, Bundoran.
"	elegans, ...	Ballintrillick, Bundoran.
"	fimbriata, ...	Bundoran, Bundoran.
"	"	Ballintrillick, Bundoran.
"	granulosa, ...	Manorhamilton, Manorhamilton.
"	"	Rush, Rush.
"	hemispherica, ...	Ballintrillick, Bundoran.
"	"	Rush, Rush.
"	latissima, ...	Kesh, Fermanagh
"	lobata, ...	Ballintrillick, Bundoran.
"	longispina, ...	Finner, Bundoran.
"	"	Abbeybay, Ballyshannon.
"	"	Bundoran, Bundoran.
"	margaritacea, ...	Bundoran, Bundoran.
"	"	Ballintrillick, Bundoran.
"	"	Finner, Bundoran.
"	Martini, ...	Finner, Bundoran.
"	membranacea, ...	Rush, Rush.
"	ovalis, ...	Bundoran, Bundoran.
"	pectinoides, ...	Abbeybay, Ballyshannon.
"	"	Ballintrillick, Bundoran.
"	pugilis, ...	Manorhamilton, Manorhamilton.
"	"	Ballintrillick, Bundoran.
"	punctata, ...	Bundoran, Bundoran.
"	quincuncialis, ...	Bundoran, Bundoran.
"	rugata, ...	Rush, Rush.
"	scabricula, ...	Bundoran, Bundoran.
"	Scotica, ...	Ballintrillick, Bundoran.
"	setosa, ...	Bundoran, Bundoran.
"	"	Ballintrillick, Bundoran.
"	"	Finner, Bundoran.
"	spinosa, ...	Ballintrillick, Bundoran.
"	sulcata, ...	Ballintrillick, Bundoran.
"	"	Bundoran, Bundoran.
Leptagonia	analoga, ...	Ballintrillick, Bundoran.
"	"	Abbeybay, Ballyshannon.
"	plicatilis, ...	Rush, Rush.
Leptaena	convoluta, ...	Ballintrillick, Bundoran.
"	"	Rush, Rush.
"	crassistria, ...	Finner, Bundoran.
"	"	Bundoran, Bundoran.
"	Hardrensis, ...	Ballintrillick, Bundoran.
"	"	Finner, Bundoran.
"	"	Bundoran, Bundoran.
"	papyracea, ...	Courtlough, Man of War, Balbriggan.
"	sordida, ...	Bundoran, Bundoran.
"	volva, ...	Bundoran, Bundoran.

Names of Fossils.		Localities and Post-Towns.
Genera.	Species.	
Orthis	arcuata, ...	Manorhamilton, Manorhamilton.
"	crenistria, ...	Bundoran, Bundoran.
"	"	Ballintrillick, Bundoran.
"	filiaria, ...	Finner, Bundoran.
"	"	Abbeybay, Ballyshannon.
"	papilionacea, ...	Bundoran, Bundoran.
"	parallela, ...	Bundoran, Bundoran.
"	quadrata ?	Ballintrillick, Bundoran.
"	radialis, ...	Ballintrillick, Bundoran.
"	resupinata, ...	Ballintrillick, Bundoran.
"	"	Bundoran, Bundoran.
"	semicircularis, ...	Abbeybay, Ballyshannon.
"	tenuistriata ?	Ballintrillick, Bundoran.
Spirifera	attenuata, ...	Bundoran, Bundoran.
"	"	Finner, Bundoran.
"	biculcata, ...	Ballintrillick, Bundoran.
"	calcarata, ...	Bundoran, Bundoran.
"	crispa, ...	Ballintrillick, Bundoran.
"	gigantea, ...	Finner, Bundoran.
"	"	Abbeybay, Ballyshannon.
"	"	Bundoran, Bundoran.
"	octoplicata, ...	Bundoran, Bundoran.
"	ostiolata, ...	Ballintrillick, Bundoran.
"	"	Bundoran, Bundoran.
"	speciosa, ...	Bundoran, Bundoran.
"	"	Ballintrillick, Bundoran.
"	"	Abbeybay, Ballyshannon.
"	Urii, ...	Ballintrillick, Bundoran.
"	"	Manorhamilton, Manorhamilton.
Cyrtia	distans, ...	Bundoran, Bundoran.
"	laminosa, ...	Ballintrillick, Bundoran.
"	"	Abbeybay, Ballyshannon.
"	"	Finner, Bundoran.
"	subconica, ...	Bundoran, Bundoran.
Martinia	glabra, ...	Ballintrillick, Bundoran.
"	plebeia, ...	Ballintrillick, Bundoran.
"	"	Finner, Bundoran.
Reticularia	imbricata, ...	Ballintrillick, Bundoran.
"	lineata, ...	Rush, Rush.
"	microgemma, ...	Bundoran, Bundoran.
Brachythyris	duplicicosta, ...	Ballintrillick, Bundoran.
"	exarata, ...	Ballintrillick, Bundoran.
"	integricosta, ...	Bundoran, Bundoran.
"	"	Ballintrillick, Bundoran.
"	pinguis, ...	Ballintrillick, Bundoran.
"	planata, ...	Bundoran, Bundoran.
"	"	Ballintrillick, Bundoran.
Athyris	concentrica, ...	Finner, Bundoran.
"	decussata, ...	Manorhamilton, Manorhamilton.
"	"	Abbeybay, Ballyshannon.
"	expansa, ...	Finner, Bundoran.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Athyris	fimbriata, ...	Bundoran, Bundoran.
"	glabristria, ...	Bundoran, Bundoran.
Atrypa	fallax, ...	Ballintrillick, Bundoran.
"	hastata, ...	Ballintrillick, Bundoran.
"	juvenis, ...	Rush, Rush.
"	pleurodon, ...	Abbeybay, Ballyshannon.
"	semisulcata, ...	Rush, Rush.
"	"	Walterstown, Skreen.
"	sulcirostris, ...	Ballintrillick, Bundoran.
"	ventilabrum, ...	Manor Hamilton, Manorhamilton.
Seminula	pentahedra, ...	Ballintrillick, Bundoran.
	CRUSTACEA.	
Griffithides	obsoletus, ...	Ballintrillick, Bundoran.
Phillipsia	gemmulifera, ...	Ballintrillick, Bundoran.
Cythere	gibberula, ...	Ballintrillick, Bundoran.
"	scutulum, ...	Ballintrillick, Bundoran.
	ANNELIDA.	
Serpula ?	compressa, ...	Bundoran, Bundoran.
"	hexicarinata, ...	Bundoran, Bundoran.
"	parallela, ...	Ballintrillick, Bundoran.
"	"	Finner, Bundoran.
"	"	Abbeybay, Ballyshannon.
Spirorbis	globosus, ...	Ballymacan, Clogher.
Serpulites	carbonarius, ...	Manorhamilton, Manorhamilton.
	ECHINODERMATA.	
Palæchinus	Kœnigii, ?	Finner, Bundoran.
Echinocrinus	glabrispina, ...	Bundoran, Bundoran.
"	Urii, ...	Ballintrillick, Bundoran.
"	"	Bundoran, Bundoran.
Platycrinus	expansus, ...	Finner, Bundoran.
"	laciniatus, ...	Finner, Bundoran.
Taxocrinus	polydactylus, ...	Ballintrillick, Bundoran.
"	"	Carrowmably, Easky.
Cyathocrinus	ellipticus, ...	Finner, Bundoran.
"	pinnatus ?	Bundoran, Bundoran.
"	planus, ...	Belmore Mountain.
"	variabilis, ...	Ballintrillick, Bundoran.
Actinocrinus	tenuistriatus, ...	Bundoran, Bundoran.
	ACRITA.	
	ZOOPHYTA.	
Turbinolia	fungites, ...	Swanlinbar, Ballyconnell.
Siphonophyllia	cylindrica, ...	Manorhamilton, Manorhamilton.

Names of Fossils.		Localities and Post-Towns.
Genera.	Species.	
Lithodendron	affine, ...	Manorhamilton, Manorhamilton.
"	sociale, ...	Ballintrillick, Bundoran.
Favosites ?	megastoma ?	Bundoran, Bundoran.
"	spongites, ...	Ballintrillick, Bundoran.
"	tenuisepta, ...	Finner, Bundoran.
Verticillopora	abnormis ?	Ballintrillick, Bundoran.
Flustra	palmata, ...	Manorhamilton, Manorhamilton.
Millepora	gracilis, ...	Ballintrillick, Bundoran.
"	oculata, ...	Ballintrillick, Bundoran.
"	"	Rush, Rush.
Jania	crassa, ...	Abbeybay, Ballyshannon.
Glauconome	bipinnata, ...	Bundoran, Bundoran.
"	pluma, ...	Bundoran, Bundoran.
"	"	Finner, Bundoran.
Fenestella	antiqua, ...	Ballintrillick, Bundoran.
"	polyporata, ...	Ballintrillick, Bundoran.
"	nodulosa, ...	Ballintrillick, Bundoran.
"	reticularis, ...	Bundoran, Bundoran.
"	tenuifila, ...	Ballintrillick, Bundoran.
"	undulata, ...	Ballintrillick, Bundoran.
Hemitrypa	Hibernica, ...	Ballintrillick, Bundoran.

SECTION II.—DIVISION III.

The Third-Division of the Limestone Group, or Upper Limestone.

Names of Fossils.		Localities and Post-Towns.
Genera.	Species.	
MOLLUSCA.		
CEPHALOPODA.		
SIPHONIFERA OR TETRABRANCHIATA.		
Family.—ORTHOCERATIDÆ.		
Orthoceras	attenuatum, ...	Castlecreagh, Doneraile.
"	"	Black Lion, Enniskillen.
"	cylindraceum, ...	Ballycastle, Antrim.
"	"	Black Lion, Enniskillen.
"	pyramidale, ...	Doneraile, Cork.
Loxoceras	Breynii, ...	Streamhill, Doneraile.
"	laterale, ...	Doneraile, Cork.
Campyloceras	arcuatum, ...	Black Lion, Enniskillen.
Cycloceras	annulare, ...	Ballycastle, Antrim.
"	lineolatum, ...	Doneraile, Cork.

Names of Fossils. Genera.	Names of Fossils. Species.	Localities and Post-Towns.
Family.—Nautilidæ.		
Goniatites	excavatus,	Black Lion, Enniskillen.
"	obtusus,	Doneraile, Cork.
"	striolatus,	Black Lion, Enniskillen.
Discites	mutabilis,	Annagh, Charleville.
"	sulcatus,	Black Lion, Enniskillen.
Temnocheilus	globatus,	Fortwilliam, Doneraile.
Nautilus	cyclostomus,	Black Lion, Enniskillen.
Bellerophon	reticulatus,	Ballycastle, Antrim.
Euphemus	Urii,	Ballycastle, Antrim.
Gasteropoda.		
Pectinibranchiata.		
Turritella	suturalis,	Black Lion, Enniskillen.
Naticopsis	Phillipsii,	Streamhill, Doneraile.
"	spirata,	Black Lion, Enniskillen.
Murchisonia	quadricarinata,	Black Lion, Enniskillen.
Scutibranchia and Cyclobranchia.		
Acroculia	vetusta,	Manorhamilton, Manorhamilton.
Dithyra.		
Macrotrachia.		
Solenopsis	minor,	Drumreagh, Dungannon.
Sanguinolites	Iridinoides,	Roughan, Dungannon.
"	radiatus,	Killymeal, Dungannon.
Lutraria	prisca,	Black Lion, Enniskillen.
Cypricardia	cuneata,	Black Lion, Black Lion.
Atrachia.		
Nucula	attenuata,	Ballycastle, Antrim.
Arca	cancellata,	Black Lion, Black Lion.
Cucullæa	arguta,	Black Lion, Enniskillen.
Byssoarca	costellata,	Black Lion, Enniskillen.
"	reticulata,	Black Lion, Enniskillen.
Lanistes	obtusus,	Killymeal, Dungannon.
Inoceramus	vetustus,	Black Lion, Enniskillen.
Meleagrina	quadrata,	Black Lion, Enniskillen.
"	radiata,	Black Lion, Enniskillen.
"	"	Carrowtremal, Enniskillen.
"	tessellata,	Knockninny, Enniskillen.
Pteronites	semisulcatus,	Black Lion, Black Lion.
"	"	Killymeal, Dungannon.
Avicula	gibbosa,	Manorhamilton, Manorhamilton.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Lima	alternata,	Killymeal, Dungannon.
"	decussata,	Killymeal, Dungannon.
"	lævigata,	Black Lion, Enniskillen.
Pecten	æqualis,	Killymeal, Dungannon.
"	arenosus,	Knockninny, Enniskillen.
"	asperulus,	Black Lion, Black Lion.
"	cancellatulus,	Killymeal, Dungannon.
"	concentrico-striatus,	Killymeal, Dungannon.
"	ellipticus,	Killymeal, Dungannon.
"	flabellulum,	Ballycastle, Antrim.
"	gibbosus,	Black Lion, Enniskillen.
"	granosus,	Killymeal, Dungannon.
"	granulosus,	Ballyconnell, Ballyconnell.
"	intercostatus,	Killymeal, Dungannon.
"	interstitialis,	Knockninny, Enniskillen.
"	"	Black Lion, Enniskillen.
"	"	Carrowtremal, Enniskillen.
"	Jonesii,	Black Lion, Black Lion.
"	megalotis,	Black Lion, Enniskillen.
"	"	Ballintrillick, Bundoran.
"	tripartitus,	Killymeal, Dungannon.
	Brachiopoda.	
Producta	aculeata,	Old Leighlin, Leighlin Bridge.
"	"	Manorhamilton, Manorhamilton.
"	concinna,	Black Lion, Enniskillen.
"	"	Killymeal, Dungannon.
"	"	Belmore Mountain.
"	corrugata,	Black Lion, Enniskillen.
"	costellata,	Old Leighlin, Leighlin Bridge.
"	Edelburgensis,	Ballycastle, Antrim.
"	elegans,	Manorhamilton, Manorhamilton.
"	gigantea,	Killymeal, Dungannon.
"	granulosa,	Black Lion, Enniskillen.
"	latissima,	Bannaghagole, Leighlin Bridge.
"	"	Killymeal, Dungannon.
"	"	Cartronaglogh, Keadue.
"	laxispina,	Black Lion, Enniskillen.
"	"	Manorhamilton, Manorhamilton.
"	Martini,	Ballycastle, Antrim.
"	"	Killymeal, Dungannon.
"	mesoloba,	Black Lion, Enniskillen.
"	pectinoides,	Black Lion, Enniskillen.
"	pugilis,	Ballintrillick, Bundoran.
"	punctata,	Knockninny, Enniskillen.
"	"	Old Leighlin, Leighlin Bridge.
"	pustulosa,	Black Lion, Enniskillen.
"	quincuncialis,	Old Leighlin, Leighlin Bridge.
"	rugata,	Black Lion, Black Lion.
"	scabricula,	Ballycastle, Antrim.

Names of Fossils.		Localities and Post-Towns.
Genera.	Species.	
Producta	Scotica, ...	Ballycastle, Antrim.
"	setosa, ...	Black Lion, Enniskillen.
"	"	Ballintrillick, Bundoran.
"	spinosa, ...	Black Lion, Enniskillen.
"	sulcata, ...	Knockninny, Enniskillen.
"	"	Black Lion, Enniskillen.
"	"	Cartronaglogh, Keadue.
Leptagonia	analoga, ...	Black Lion, Enniskillen.
"	plicatilis, ...	Manorhamilton, Manorhamilton.
Leptæna	Hardrensis, ...	Old Leighlin, Leighlin Bridge.
"	"	Ballycastle, Antrim.
Orthis	crenistria, ...	Black Lion, Enniskillen.
"	filiaria, ...	Old Leighlin, Leighlin Bridge.
"	"	Bannaghagole, Leighlin Bridge.
"	resupinata, ...	Carrowtremal, Enniskillen.
Spirifera	attenuata, ...	Black Lion, Enniskillen.
"	bisulcata, ...	Black Lion, Enniskillen.
"	gigantea, ...	Manorhamilton, Manorhamilton.
"	minima, ...	Churchill, Fermanagh.
"	"	Black Lion, Enniskillen.
"	"	Old Leighlin, Leighlin Bridge.
"	rhomboidea, ...	Knockninny, Enniskillen.
"	"	Black Lion, Enniskillen.
"	speciosa, ...	Manorhamilton, Manorhamilton.
Cyrtia	linguifera, ...	Black Lion, Enniskillen.
"	semicircularis, ...	Ballycastle, Antrim.
Martinia	plebeia, ...	Black Lion, Enniskillen.
Reticularia	imbricata, ...	Black Lion, Enniskillen.
"	reticulata, ...	Ballycastle, Antrim.
"	"	Bannaghagole, Leighlin Bridge.
Brachythyris	exarata, ...	Old Leighlin, Leighlin Bridge.
"	pinguis, ...	Cartronaglogh, Keadue.
"	planicostata, ...	Old Leighlin, Leighlin Bridge.
"	"	Bannaghagole, Leighlin Bridge.
"	"	Killymeal, Dungannon.
Athyris	fimbriata, ...	Black Lion, Enniskillen.
"	globularis, ...	Churchill, Fermanagh.
Actinoconchus	paradoxus, ...	Black Lion, Enniskillen.
TEREBRATULIDÆ.		
Atrypa	flexistria, ...	Knockninny, Enniskillen.
"	hastata, ...	Black Lion, Enniskillen.
"	pleurodon, ...	Black Lion, Enniskillen.
"	pugnus, ...	Black Lion, Enniskillen.
"	sacculus, ...	Black Lion, Enniskillen.
"	sulcirostris, ...	Knockninny, Enniskillen.
"	ventilabrum, ...	Black Lion, Enniskillen.
Seminula	rhomboidea, ...	Black Lion, Enniskillen.
Griffithides	calcaratus, ...	Roughan, Dungannon.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Griffithides	obsoletus,	Cartronaglogh, Keadue.
Phillipsia	cælata,	Killymeal, Dungannon.
Entomoconchus	Scouleri,	Black Lion, Enniskillen.
	ECHINODERMATA.	
Echinocrinus	Urii,	Manorhamilton, Manorhamilton.
Pentremites	Derbiensis,	Knockninny, Enniskillen.
"	"	Manorhamilton, Manorhamilton.
"	ellipticus,	Manorhamilton, Manorhamilton.
"	florealis,	Black Lion, Enniskillen.
Cyathocrinus	variabilis,	Ballintrillick, Bundoran.
Actinocrinus	constrictus,	Manorhamilton, Manorhamilton.
"	costus,	Manorhamilton, Manorhamilton.
"	triacontadactylus,	Manorhamilton, Manorhamilton.
	ACRITA.	
	ZOOPHYTA.	
Amplexus	tortuosus,	Black Lion, Enniskillen.
Turbinolia	fungites,	Belmore Mountain, Enniskillen.
Lithostrotion	striatum,	Bannaghagole, Leighlin Bridge.
"	"	Raheendoran, Carlow.
Lithodendron	affine,	Pulgulin, Swanlinbar.
"	"	Ballyconnell, Ballyconnell.
"	cæspitosum,	Raheendoran, Carlow.
Syringopora	laxa,	Killymeal, Dungannon.
Favosites	septosus,	Raheendoran, Carlow.
"	spongites,	Black Lion, Enniskillen.
"	tumida,	Ballycastle, Antrim.
"	"	Belmore Mountain, Enniskillen.
"	"	Killymeal, Dungannon.
Tragos	semicirculare,	Manorhamilton, Manorhamilton.
Vincularia	dichotoma,	Black Lion, Enniskillen.
"	"	*Incerti loci.*
"	megastoma,	Killymeal, Dungannon.
"	parallela,	Killymeal, Dungannon.
"	raricosta,	Killymeal, Dungannon.
Glauconome	bipinnata,	Black Lion, Enniskillen.
"	gracilis,	Killymeal, Dungannon.
"	pluma,	Black Lion, Enniskillen.
"	"	Belmore Mountain, Enniskillen.
"	"	Killymeal, Dungannon.
"	pulcherrima,	Black Lion, Black Lion.
Fenestella	crassa,	Black Lion, Black Lion.
"	ejuncida,	Black Lion, Enniskillen.
"	formosa,	Killymeal, Dungannon.
"	frutex,	Killymeal, Dungannon.
"	laxa,	Belmore Mountain, Enniskillen.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Fenestella	laxa, ...	Black Lion, Enniskillen.
"	multiporata, ...	Ballintrillick, Bundoran.
"	"	Killymeal, Dungannon.
"	nodulosa, ...	Black Lion, Enniskillen.
"	"	Ballintrillick, Bundoran.
"	polyporata, ...	Black Lion, Enniskillen.
"	quadradecimalis, . . .	Black Lion, Enniskillen.
"	tenuifila, ...	Black Lion, Enniskillen.
"	"	Ballintrillick, Bundoran.
"	undulata, ...	Black Lion, Enniskillen.
"	varicosa, ...	Black Lion, Black Lion.
Hemitrypa	Hibernica, ...	Ballintrillick, Bundoran.
"	"	Black Lion, Enniskillen.
"	"	Knockninny, Enniskillen.
Polypora	marginata, ...	Killymeal, Dungannon.
"	"	Black Lion, Enniskillen.
"	papillata, ...	Killymeal, Dungannon.
"	"	Black Lion, Enniskillen.
"	verrucosa, ...	Black Lion, Enniskillen.
Lower Carboniferous Fishes.		
Palæoniscus	sp.	Moyheeland, Draperstown.
"	"	Mormeal.
"	"	Cultra, Hollywood.
Amblypterus	sp.	Ballynure, Maghera.
"	"	Moyheeland, Draperstown.
Psammodus	porosus, ...	Hook Head, Fethard.
"	"	Malahide, Dublin.
"	"	Finner, Bundoran.
"	"	Red Barn, Armagh.
Helodus	sp.	Red Barn, Armagh.
"	"	Ballygasey, Loughgall.
"	mammillaris, ...	Ballinglen, Ballycastle.
"	"	Loughgall, Armagh.
"	planus, ...	Kilcummin, Lackan Bay.
"	turgidus, ...	Red Barn, Armagh.
Chomatodus	sp.	Red Barn, Armagh.
Cochliodus	sp.	Poulscadden, Howth.
"	"	Cookstown, Tyrone.
"	contortus, ...	Ballygasey, Loughgall.
"	gracilis, ...	Millicent, Clane.
"	magnus, ...	Finner, Bundoran.
"	"	Red Barn, Armagh.
"	"	Ballygasey, Loughgall.
Cladodus	sp.	College Hall, Tynan.
"	"	Red Barn, Armagh.
"	mirabilis, ...	Drummanbeg, Armagh.
Petalodus	Hastingsiæ, ...	Enagh, Tynan.
"	"	Ballygasey, Loughgall.
"	lævissimus, ...	Red Barn, Armagh.
"	radicans (palatal tritor),	Red Barn, Armagh.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Petalodus	sp.	Ballygasey, Loughgall.
"	sagittatus, ...	Red Barn, Armagh.
Ctenacanthus	sp.	Monaduff, Drumlish.
"	"	Ballygasey, Loughgall.
Asteroptychius	ornatus, ...	Ballygasey, Loughgall.
Oracanthus	Milleri, ...	Monaduff, Drumlish.
Onchus?	sp.	Ballygasey, Loughgall.
Pœcilodus	"	River Banagh.
"	Jonesi, ...	Red Barn, Armagh.
"	sublævis, ...	Red Barn, Armagh.
"	transversus, ...	Red Barn, Armagh.
"	"	Ballygasey, Loughgall.
Gyracanthus	obliquus, ...	Moyheeland, Draperstown.
"	new?	Moyheeland, Draperstown.
"	tuberculatus, ...	Moyheeland, Draperstown.
"	spines, ...	Cultra, Hollywood.
Holoptychius	sp.	Moyheeland, Draperstown.
"	"	Fallagloon, Maghera.
"	Portlocki, ...	Ballynure, Maghera.
"	"	Fallagloon, Maghera.
"	"	Moyheeland, Draperstown.
"	"	Cultra, Hollywood.
"	"	Monaduff, Drumlish.
Phyllolepis	sp.	Moyheeland, Draperstown.
Chelyophorus	Griffithii, ...	Cultra, Hollywood.
Isodus	leptognathus, ...	Moyheeland, Draperstown.
Psammosteus	vermicularis, ...	Fallagloon, Maghera.
"	granulatus, ...	River Banagh, Kesh.

Section III.

The Coal Group, or Third Section of the Series, consists of the Millstone Grit, and the overlying Coal proper, or uppermost member of the Carboniferous System.

Section III.—Division I.

The Millstone Grit.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
	Cephalopoda.	
	Orthoceratidæ.	
Orthoceras	cinctum,	Cahernanalt, Keadue.
"	filiferum,	Cahernanalt, Keadue.
"	inæquiseptum,	Cahernanalt, Keadue.
"	laterale,	Derreens, Drumkeeran.
"	"	Skehana, Castlecomer.
"	serratum,	Corry, Drumkeeran.
"	Steinhaueri,	Caher Rush, Milltown Malbay.
"	sulcatulum,	Cahernanalt, Keadue.
"	"	Cuilcagh, Swanlinbar.
Actinoceras	giganteum,	Foynes, Askeaton.
"	"	Cahernanalt, Keadue.
Cyrtoceras	alternatum,	Corry, Drumkeeran.
	Nautilidæ.	
Goniatites	Gilbertsoni,	Cahernanalt, Keadue.
"	Listeri,	Cahernanalt, Keadue.
"	"	Ballybunnion, Co. Kerry.
"	Looneyi,	Cahernanalt, Keadue.
"	micronotus,	Braulieve Mountains, Black Lion.
"	ovatus,	Derreens, Drumkeeran.
"	reticulatus,	Doon, Mount Phelim, Ennistymon.
"	serpentinus,	Cahernanalt, Keadue.
"	striolatus,	Cahernanalt, Keadue.
"	"	Skehana, Castlecomer.
"	vittiger,	Cahernanalt, Keadue.
Nautilus	discors,	Corry, Drumkeeran.
"	Luidii,	Cahernanalt, Keadue.
"	"	Cuilcagh, Swanlinbar.
"	"	Derreens, Drumkeeran.
"	sigmilineus,	Corry, Drumkeeran.
"	spiralis,	Kingwilliamstown, Co. Cork.
	Gasteropoda.	
Euomphalus	parvus,	Skehana, Castlecomer.
Macrocheilus	scaraboides,	Corry, Drumkeeran.

Names of Fossils. Genera.	Names of Fossils. Species.	Localities and Post-Towns.
Littorina	nuciformis,	Cuileagh, Swanlinbar.
„	carinata,	Rock of Foyle Waterfall, Castlecomer.
Pleurotomaria	ornata,	Corry, Drumkeeran.
Turbo	sp.	Cahernanalt, Keadue.
Patella	mucronata,	Cahernanalt, Keadue.
	DITHYRA.	
Pullastra	elegans,	Cahernanalt, Keadue.
„	„	Rock of Foyle Waterfall, Castlecomer.
Lunulacardium	new sp., two of,	Cahernanalt, Keadue.
Cypricardia	alata,	Firoda, Castlecomer.
„	socialis,	Cahernanalt, Keadue.
Posidonia	Becheri,	Alteen Stream, Swanlinbar.
„	„	Cuilcagh, Swanlinbar.
„	„	Ennistymon.
„	lateralis,	Cahernanalt, Keadue.
„	membranacea,	Cahernanalt, Keadue.
„	„	Firoda, Castlecomer.
„	pusilla,	Braulieve Mountains, Black Lion.
Modiola	sp.	Bilboa Colliery, Carlow.
Pecten	concentricus,	Cahernanalt, Keadue.
„	ellipticus,	Cahernanalt, Keadue.
„	granulosus,	Cahernanalt, Keadue.
„	variabilis,	Cahernanalt, Keadue.
„	papyraceus,	Corry, Drumkeeran.
„	„	Skehana, Castlecomer.
„	„	Cahernanalt, Keadue.
Unio	sp.	Coal Island, Dungannon.
Lingula	parallela,	Coal Island, Dungannon.
„	„	Ennistymon.
	BRACHIOPODA.	
Orbicula	sp.	Mullaun, Keadue.
Producta	concinna,	Cuilcagh, Swanlinbar.
„	„	Rock of Foyle Waterfall, Castlecomer.
„	setosa,	Cahernanalt, Keadue.
„	mesoloba,	Rock of Foyle Waterfall, Castlecomer.
Leptæna	Hardrensis,	Cahernanalt, Keadue.
Orthis	parallela,	Rock of Foyle Waterfall, Castlecomer.
Spirifera	crispa,	Cahernanalt, Keadue.
„	glabra,	Cahernanalt, Keadue.
„	„	Rock of Foyle Waterfall, Castlecomer.
„	rotundata,	Corry, Drumkeeran.
„	Urii,	Lough Allen, Carrick-on-Shannon.
Atrypa	semisulcata,	Cahernanalt, Keadue.
	CRUSTACEA.	
Griffithides	globiceps,	Cahernanalt, Keadue.
„	„	Firoda, Castlecomer.
Phillipsia	gemmulifera,	Cahernanalt, Keadue.
„	„	Rock of Foyle Waterfall, Castlecomer.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
ECHINODERMATA.		
Cyathocrinus	ellipticus, ...	Cahernanalt, Keadue.
Actinocrinus	tenuistriatus, . . .	Cahernanalt, Keadue.
ZOOPHYTA.		
Fenestella	antiqua, ...	Cahernanalt, Keadue.
PLANTS.		
Plants, Lepidodendron, &c., as in Coal, .		Ballycastle Colliery, Antrim, &c.
"		Raheen, Leighlin Bridge.
"		Cahir Rush, Milltown Malbay.
Fern stem, ...		Cahernanalt, Keadue.

SECTION III.—DIVISION II.

The uppermost member of the Carboniferous Series, or Coal Proper.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
Bivalve shells and Trilobites, ...		Bilboa Colliery, Carlow.
PLANTS.		
DICOTYLEDONS.		
Stigmaria	ficoides, ...	Dromagh Colliery, Kanturk.
"	"	Aghabehy, Keadue.
Sigillaria	organum, ...	Dromagh Colliery, Kanturk.
"	"	Crosshill, Keadue.
Favularia	elegans, ...	Annagher Colliery, Coal Island.
Sphenophyllum	erosum, ...	Annagher Colliery, Coal Island.
Asterophyllites	longifolia, ...	Dromagh Colliery, Kanturk.
"	tuberculata, . . .	New Birmingham, Co. Tipperary.
Pinnularia	capillacea, ...	Dromagh Colliery, Kanturk.
"	"	Annagher Colliery, Coal Island.
Bechera	grandis, ...	Annagher Colliery, Coal Island.
CELLULARES.		
EQUICETACEÆ.		
Calamites	approximatus, . .	New Birmingham, Co. Tipperary.
"	cannæformis, . .	Annagher Colliery, Coal Island.
"	Mougeotii, . . .	New Birmingham, Co. Tipperary.
"	Suckowii, ...	Annagher Colliery, Coal Island.

Names of Fossils. Genera.	Species.	Localities and Post-Towns.
FILICES.		
Sphenopteris	dilatata, ...	Annagher Colliery, Coal Island.
,,	,,	Dromagh Colliery, Kanturk.
,,	Hibbertii, ...	Annagher Colliery, Coal Island.
,,	latifolia, ...	Annagher Colliery, Coal Island.
,, (new)	allied to Höningausi,	Aghabehy, Keadue.
,,	,,	New Birmingham, Co. Tipperary.
,,	obtusiloba, ...	Queen's County, Leinster Coal-field.
,,	Schlotheimii, . . .	Dromagh Colliery, Kanturk.
,,	,,	Annagher Colliery, Coal Island.
Neuropteris	acuminata, ...	Annagher Colliery, Coal Island.
,,	gigantea, ...	Annagher Colliery, Coal Island.
,,	rotundifolia, . . .	Annagher Colliery, Coal Island.
,,	tenuifolia, ...	Annagher Colliery, Coal Island.
Odontopteris	obtusa, ...	Annagher Colliery, Coal Island.
Pecopteris	muricata, ...	Annagher Colliery, Coal Island.
,,	lonchitica, ...	Dromagh Colliery, Kanturk.
,,	polymorpha, . . .	Aghabehy, Keadue.
,,	Serlii, ...	Annagher Colliery, Coal Island.
,,	,,	Dromagh Colliery, Kanturk.
LYCOPODIACEÆ.		
Lepidodendron	aculeatum, ...	Ballycastle Colliery, Co. Antrim.
,,	dilatatum, ...	Crosshill, Keadue.
,,	elegans, ...	Dromagh & Gurteen Collieries, Kanturk.
,,	,,	Crosshill and Aghabehy, Keadue.
,,	Harcourtii, ...	Ballycastle Collieries, Co. Antrim.
,,	obovatum, ...	Aghabehy, Keadue.
,,	rimosum, ...	Dromagh Colliery, Kanturk.
,,	selaginoides, ...	Dromagh Colliery, Kanturk.
,,	Sternbergii, ...	Dromagh Colliery, Kanturk.
Ulodendron	minus, ...	Dromagh Colliery, Kanturk.
,,	,,	Gurteen Colliery, Kanturk.

TABLE SHOWING THE DISTRIBUTION OF THE FOSSILS THROUGHOUT THE SEVERAL MEMBERS OF THE CARBONIFEROUS SYSTEM BELOW THE COAL SERIES.

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp, or Mid. Li.	Upper Li. *
MOLLUSCA OR HETEROGANGANGLIATA.		*	*	*	*	*	*	*
CEPHALOPODA.		. .	*	*	*	*	*	*
SIPHONIFERA OR TETRABRANCHIATA.		. .	*	*	*	*	*	*
ORTHOCERATIDÆ.		. .	*	*	*	*	*	*
Orthoceras	attenuatum, .	. .	*	*	. .	*	*	*
”	cinctum, . .	. .	. .	. .	. .	*	*	. .
”	cylindraceum,	. .	. .	. .	*	*	. .	*
”	filiferum, . .	. .	. .	. .	*	. .	. .	. .
”	mucronatum, .	. .	. .	. .	. .	. .	*	. .
”	ovale, ...	. .	. .	. .	. .	*	. .	. .
”	pyramidale, .	. .	. .	. .	. .	*	. .	*
”	striatum, . .	. .	. .	. .	. .	*	. .	. .
Loxoceras	Breynii, . . .	. .	. .	. .	. .	*	. .	*
”	distans, . . .	. .	. .	. .	. .	*	. .	. .
”	incomitatum, .	. .	. .	. .	*	. .	. .	. .
”	laterale, . . .	. .	. .	. .	*	*	*	*
Campyloceras	arcuatum, . . .	. .	. .	. .	. .	. .	. .	*
”	unguis, . . .	. .	. .	. .	. .	*	. .	. .
Cycloceras	annulare, . .	. .	. .	. .	. .	. .	. .	*
”	lævigatum, .	. .	. .	. .	. .	*	. .	. .
”	lineolatum, .	. .	. .	. .	. .	. .	. .	*
Poterioceras	fusiforme, . .	. .	. .	. .	. .	*	. .	. .
”	ventricosum, .	. .	. .	. .	. .	*	. .	. .
Actinoceras	giganteum, .	. .	*	. .	. .	*	. .	. .
”	pyramidatum,	. .	*	. .	. .	. .	. .	. .
Cyrtoceras	tuberculatum,	. .	*	. .	. .	*	*	. .
Phragmoceras	flexistria, . .	. .	. .	*	. .	. .	. .	. .
NAUTILIDÆ.		*	*	*	*	*	*	*
Goniatites	discus, . . .	. .	. .	. .	. .	*	. .	. .
”	excavatus, . .	. .	. .	. .	. .	*	. .	*
”	fasciculatus, .	. .	. .	. .	. .	*	. .	. .
”	Gibsoni, . . .	. .	. .	. .	*	. .	*	. .
”	intercostalis, .	. .	*	. .	. .	*	. .	. .
”	latus, ...	. .	. .	. .	. .	*	. .	. .
”	Listeri, . . .	. .	. .	. .	. .	*	. .	. .
”	micronotus, .	. .	. .	. .	. .	*	. .	. .
”	mutabilis, . .	. .	. .	. .	. .	*	. .	. .
”	obtusus, . . .	. .	. .	. .	. .	*	. .	*

* The above contractions are as follow:—Y. Sand., Yellow Sandstone; Ar. Li., Arenaceous Limestone; Ar. Sh., Arenaceous Shale; Carb. Sl., Carboniferous Slate; Lower Li., Lower Limestone; Mid. Li., Middle Limestone; Upper Li., Upper Limestone.

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp, or Mid. Li.	Upper Li.
Goniatites	ovatus,					*		
"	reticulatus,		*					
"	sphæroidalis,					*		
"	striatus,				*			
"	striolatus,				*	*		*
"	truncatus,					*		
Clymenia	sagittalis,			*				
Discites	costellatus,					*		
"	discors,					*		
"	latidorsatus,					*		
"	mutabilis,							*
"	oxystomus,				*			
"	planotergatus,					*		
"	subsulcatus,					*		
"	sulcatus,		*		*	*		
"	tetragonus,			*	*			
"	trochlea,					*		
Temnocheilus	biangulatus,			*		*		
"	cariniferus,					*		
"	coronatus,					*		
"	costalis,					*		
"	crenatus,					*		
"	furcatus,					*		
"	globatus,							*
"	multicarinatus,					*		
"	pinguis,					*		
"	porcatus,				*			
"	sulciferus,					*		
"	tuberculatus,		*			*		
Nautilus	cyclostomus,					*		*
"	dorsalis,					*		
Bellerephon	apertus,		*		*	*		
"	cornu-arietis,		*		*	*		
"	costatus,					*		
"	hiulcus,				*	*		
"	lævis,					*		
"	obsoletus,					*		
"	reticulatus,							*
"	tangentialis,					*		
"	tenuifascia,					*		
Euphemus	intersectus,					*		
"	Urii,					*		*
Gasteropoda.		*	*	*	*	*	*	*
Pectinibranchiata.		*	*	*	*	*	*	*
Zoophaga.		*		*	*	*	*	
Macrocheilus	acutus,					*		
"	canaliculatus,			*				
"	curvilineus,			*		*		

XI.—Polar Exploration—Antarctic and Arctic (Plates VI., VII.)

By John Locke, M.R.D.S., &c.

[Read before the Royal Dublin Society, Monday Evening, November 19, 1860.]

Franklin may be termed the pioneer of modern circumpolar exploration; for, though unsuccessful himself in the unequal contest with the difficulties of discovery in Arctic climes, the example of his singularly adventurous career, as well as the devotedness of purpose displayed in the prolonged searches after this martyr of science and his brave companions, have impressed not only fresh impetus, but a new character likewise upon the enterprises of Arctic and Antarctic travel, and given new direction to the theories of scientific observers respecting those mysterious regions, hitherto barred from human ingress by unscaled escarpments of perpetual ice.

After centuries of disheartening failure in the Northern Hemisphere, the lull of public despondency is broken by a startling call from America; and a well-known indefatigable labourer in the domain of geographical research, an honorary member of our Society, Captain Maury, Director of the Observatory at Washington, points to the Southern Hemisphere,—enumerates his reasons for the probable existence of a habitable climate far within the frozen flanks of the Antarctic Zone, and chivalrously invites the British Government to join the great republic of the West in an expedition to scale the barriers and traverse the steppes of perpetual snow, sloping downward and inward, until they immerge into regions of light airs and calms,—where the air, after having precipitated all the aqueous vapour gathered from the vast reservoir which girdles the Southern hemisphere in one unbroken sweep, ascends above the normal level of the aerial ocean, and thence ebbs back with ever-flowing tide to equatorial latitudes.

In the endeavour to illustrate this topic of such strange and absorbing interest, I request attention to two diagrams,—Plate VI. representing an approximate tracing of the supposed Antarctic Continent, and showing the steamer-track, about twelve days from Port Philip, the chief naval station of the Austral seas, to some available landing point, bight, or ravine, under shadow of the precipitous coast, whence overland parties might start upon their perilous mission of discovery; Plate VII. depicts a profile view of the atmosphere. Following the outline of the outer periphery, it will be observed, that the air, like land and water, the two other principal constituents of our planet, is unequally distributed, being piled up over the belts of tropical calms, depressed over the equatorial calms, and again depressed in graduated proportion from 40° North and South, toward the polar regions.* The

* The average pressure of the atmosphere in southern latitudes, on the square foot, is from 10 lbs. to 50 lbs. less than in northern latitudes, according to the parallel. See Maury's "Physical Geography of the Sea," Introduction to *8th Edition* (Sampson Low).

fainter outer shade represents the superior atmosphere, supposed to be unaffected by meteorological change, whence no messenger comes to the earth's surface, save the transient meteorite, and refracted ray of rising or setting suns.

In the observations laid before the Society this evening, it is sought to group together the ascertained phenomena of exploration, both Arctic and Antarctic, so as to bring the aid of analogy and geographical symmetry to the solution of the latter question.

And, first, with respect to the elementary constituents of the soil—In the geological structure of extreme northern regions, the sedimentary strata are abundant and of vast extent;* while the constitution of Antarctic strata seems, on the contrary, as far as yet examined, entirely igneous. Even when landing on island or supposed continent has been found impracticable by the navigator, a like conformation has been inferred from data, that minds untrained in scientific investigation might be disposed to pretermit or contemn. Ross and his adventurous companions in the Erebus and Terror shot many birds in about latitude 74°; and on examining their crops, the pebbles found were invariably igneous or volcanic, thus intimating the composition at least of shoreward formations; and to show that this mode of inference is not so restricted as some might imagine, it may be stated, that in the crop of one of those birds, a specimen of the *Aptenodytes antarcticus*, a gigantic penguin, weighing 75lbs., now stuffed and in the Government collection, no less than one pound weight of pebbles was found of various kinds, and therefore probably picked up along a considerable range of coast; again, stones drawn up by the dredge, and debris transported by icebergs, were invariably of granitic or volcanic structure, as well as also all the islands on which landing has been effected down to the fifty-eighth degree of latitude, all literally lands of desolation, as Kerguelen was termed by Cook. The constitution, then, of Boreal and Austral lands is in direct contrast, and unfavourable to the hypothesis of a habitable region in the latter.

Still following the analogy of exhaustive probabilities by comparison of phenomena, we next proceed to notice currents and ice-drifts. In Arctic seas, during the brief summer, the detached bergs were observed by Parry driving north through Davis's Straits against the surface cold current steadily flowing to the south, being impelled by a warmer under-current, an offset from the Gulf-stream, as proved by thermometric soundings. We, Irishmen, know to our comfort the beneficent influence of that great river in the ocean, extending from its tepid sources in Mexican waters to all the north-western shores of the old world; for Ireland would be another Labrador only for that wondrous river. Now the warm under-current, flowing north, might imply, and partly account for, the existence of that mysterious Polynia, or open Arctic sea, so long and vainly sought. From a similar phenomenon, though in converse

* See the "Geological Map of Arctic Lands," by Professor Haughton, F.T.C.D., appended to M'Clintock's "Voyage of the Fox, in search of Franklin."

aspect, the probability of an open Antarctic ocean may be inferred. Wilkes, alluding to the ice-drift of the south, observes—"I should not look to a surface-current, as the motive power, that carries these immense masses of icebergs north; comparatively speaking, their great bulk is below the influence of any surface-current; and the rapid transport by means of winds is still more improbable; therefore, I conceive, we must look to an under-current as their great propeller;" "and in one trial of the deep-sea thermometer, we found the temperature beneath four degrees warmer than at the surface".* Where then can this warm under-flow have its genesis, if not in the very womb of the Antarctic, which consequently possesses a higher temperature than the engirdling waters? Indeed, the direction and breadth of the berg-drift must partially indicate the extent and nature of the shores whence it is launched, as its non-appearance indicates the probable loci of openings leading to a circumpolar ocean; for icebergs are only formed on elevated and abrupt coasts, and thence released by a lateral viscous force; or toppling sheer over by their own gravity, when their bases are eroded by deep water of comparatively high temperature, or worn away in shoal-water by the ever-dashing surf. These must be the chief detaching forces—the Arctic agents of attrition by shore-streams in the ravines and fiords during the brief summer, and expansion of water frozen in rifts or fissures, not having been noticed to any extent in these extreme southern regions, where melted snow freshets never expose the surface, and many of the ice-islands (a phenomenon almost peculiar to austral waters), dotting all the offings with their strange and fantastic forms, appear to have suffered little change since the time of Cook. Indeed, it may be, that those isolated masses possess true insular nuclei.

But, admitting the value of Wilkes' testimony as to a warmer deep current flowing northward, there are two wide and well-developed superficial cold currents flowing in same direction, one towards the Cape, the other (Humboldt's current) to the Horn, where it is bifurcated, rushing to the Falklands on the east, and on the west moderating by its cooling influences the high temperature of the Chilian and Peruvian shores. Between these is interposed the normal flow of tropical waters, slowly pressing southward, and checking the advance of the main body of the great ice fleet, while the two wings sweep forward unceasingly in flying columns, until smitten progressively by the suns of warmer climates. Icebergs are often met as low as the 37th°, while in northern latitudes, they rarely advance beyond the 55th. The higher latitudes of Antarctic waters are never visited, except by the whaler and the ardent votary of discovery; the path of the merchant or emigrant is far to the northward; even marine life is sparse in certain tracts of vast extent, and the sea-bird is seldom observed flying over such lonely wastes. Truly there are deserts in the sea, as on the land. It is probable that the great openings, communicating with undiscovered central regions, lie on either side of the currents just mentioned, and which therefore

* U. S. Expedition, vol. ii., c. 10. See, also, Sir J. C Ross, vol. i., c. 7.

may furnish an approximate index for instruction of any contemplated expedition.

Wilkes, who has mapped a more extended and continuous coast than modern navigators of other nations, only traces a broken and uncertain outline of some 1600 geographical miles. Indeed, the sum total of all the discovered coasts* do not amount to one-fourth of the circumference of the sphere, measured on the mean parallel of the several latitudes; while in a considerably higher Arctic latitude the sphere has been traversed round, and coast lines traced of unexplored regions, with only exception of the northern shores of the vast continental promontory of Greenland, along the precipitous shores of which an available path to the Polynia may yet be discovered. Again, the contrast between the limits of organic life in Arctic and Antarctic zones is very remarkable and significant. Vegetables and land animals are found at nearly 80° in the northern, while from the parallel of 58° in the southern hemisphere, the lichen, and such like plants only, clothe the rocks;† and sea birds and the cetaceous tribes alone are seen upon the desolate beaches. In Boreal climes, too, there is a strong probability, which Austral regions do not furnish, of the existence of herbaceous soils in latitudes yet intact, from the fact of migration of ruminating animals, their unerring instinct leading them to lands prolific in vegetable organisms. M'Clintock‡ describes herds of rein-deer, "a perfect forest of antlers," moving north in the summer: and it is an important fact to bear in mind, that in certain high latitudes, where the summer is short yet comparatively warm, vegetable life is more abundant than in lower latitudes, where the mean annual temperature is much higher, but the summer not so warm, and seasonal changes less distinctly marked. The eider duck and brent goose through the air, the unwieldy family of the cetacea through the waters, the Arctic bear upon the ice, the musk ox and rein-deer along the land—all wend their way northward at certain seasons; suggesting the existence of a milder circumpolar climate, and consequently of open seas; for, as a general rule, isothermals are concurrent with the ocean bends.§ Now these indications are absent from the southern zone, as is also the inhabitation of man; M'Clintock‖ stating, that the bones of musk-oxen killed by the Esquimaux were found north of 79th parallel; while in the southern hemisphere man is not found above the 56th parallel of latitude.

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* *Vide* Plate VI. Also, U. S. Expedition, vol. ii., c. 10, and charts affixed to the work.

† The vegetable kingdom has few representatives in the Antarctic. On the South Georgias, in same latitude as Yorkshire in our hemisphere, Cook did not find "a shrub big enough to make a toothpick." The South Shetlands, occupying a corresponding latitude to their namesakes in the North, present scarcely a vestige of vegetation. Kerguelen, as low as latitude 50° south, boasts 18 species of plants, of which only one, a peculiar kind of cabbage, has been found useful, in cases of scurvy; while Iceland, 15° degrees nearer to the pole in our hemisphere, boasts 870 species.—J. L.

‡ "Voyage of the Fox," c. 2.

§ "Isothermal Maps of South Pacific Ocean" have not yet been issued by Maury in his series of charts.

‖ "Voyage of the Fox," c. 2.

But, descending from higher organisms to minute forms of life, so extensively developed both in southern and northern high latitudes, Ross records a circumstance, curiously suggestive of the probability of a temperate ocean, and islands of low elevation, within the icy barriers of the south. In about latitude 74°, Coulman Island in sight, the dredge brought up from 300 fathoms, and sundry less depths, delicate specimens of the living coral.* Now naturalists are generally agreed, that this insect is incapable of working at great depths; and these corallines, being found in their living state, must have been but recently severed from the reef, and wafted (we may suppose) by the warm currents, before mentioned, from islands of comparatively mild temperature, situate within the circumpolar spaces.

There is one other class of phenomena peculiar to Austral, as distinguished from Boreal climates, which has led Captain Maury to infer the existence of a temperate clime within the icy escarpments of the Antarctic coasts. It has been long remarked by mariners, that the mean position of the barometer in Austral seas is considerably lower than in other parts of the world; and Ross observes, that "the cause of the atmospheric pressure being so very much less in the southern than in the northern hemisphere remains yet to be determined."† Mary Somerville estimates this differential quantity as equivalent to an elevation above the sea-level of 800 feet. Since 1853, observations, exceeding 100,000 in number, furnished chiefly by the logs of English, Dutch, and American navigators to the Observatory at Washington, U. S., and diligently investigated and tabulated by Captain Maury, have corroborated this curious phenomenon; from which he infers, with that ardent imaginative faculty, so often anticipative of actual discovery, that there exists a temperate region shut up behind the barrier of the Austral snows. The case may be briefly stated; still sustaining the analogy between Arctic and Antarctic zones, and assuming a question, not yet however absolutely determined,—the exactitude of relations between barometric pressure and the weather. The barometer, generally speaking, stands highest in the dry, lowest in the wet season; but in high southern latitudes it has no months of high range, and is low all the year; so that the meteorological condition of the southern is more stable than that of the northern hemisphere. In other words, there are more frequent alternations of wind, calm, fog, thunder-storm, and especially more rain, in the latter case,—notwithstanding the proportion of land to water in the north being one-half, in the south only one-eighth; so that there is four times as much water in the southern hemisphere. Now this so vastly larger evaporative expanse, on which the atmosphere rests, and in the higher latitudes as on a *continuous* engirdling base, must necessarily exhale more aqueous vapour than the equally divided land and water of the northern hemisphere; and yet the comparative phenomena

* J. C. Ross, vol. i., c. 7. See also Wilkes, U. S. Expedition, vol. ii., c. 10.

† J. C. Ross, vol. ii., c. 8 and c. 18. See also Maury's "Sailing Directions" vol. p. 446, Ed. 1859; and Somerville's "Physical Sciences," Sect. 15, 9th Edition.

of precipitation imply the contrary, as you will perceive by consulting Maury's or Johnston's rain-charts.* What, then, becomes of the excess? for the forces of evaporation and precipitation must be equal, and mutually balanced in the meteorological machinery of the wide embracing atmosphere, the universal carrier of water, as well as of light and heat, over the globe. The diminished barometric pressure in the southern hemisphere plainly declares a fact, that the test of the rain-gauge appears to deny—*i. e.*, the excess of aqueous vapour, which is one-third lighter than common air; and Maury conjectures, that this vapour must be borne within the Antarctic circle by the winds, which blow almost unceasingly towards the pole from above the 50th parallel.† These surcharged aërial currents, passing over vast desolate steppes of perpetual congelation, are reduced to an extreme degree of cold; then, being robbed of their aqueous vapour by precipitation, they receive, as sensible, the latent heat thereof; and, being further subjected to the pressure of the superincumbent atmosphere in far-removed Antarctic regions, absorb thereby a further accession of warmth, so as to produce an intern climate of comparatively mild temperature. This ingenious theory may fairly stand unquestioned, until the anomaly is reconciled by some more probable hypothesis. I am aware of the theories of Herschel and others, explanatory of the causes of the greater precipitation in the northern hemisphere; but these do not adequately account for the entire excess of evaporation in the south, especially in the region of the counter-trades. It is probable, if the Arctic pole is ever reached, that we shall find a barometric depression there also, a region of rain and mists, and a mild climate proceeding from similar causes; though such depression may be considerably less than at the Antarctic pole.‡

The probable approaches to, and nature of, the circumpolar spaces, may fitly form the next division of inferential inquiry. By actual experience, we are less acquainted with their distinctive features, than with those of some of the celestial bodies. Indeed, to an observer in the moon, the configuration would be distinctly patent of those regions, that seem barred from our exploration by unsurmounted zones of cold. The 78th parallel of southern latitude has been reached by Ross, but no dis-

* The Rain-gauge gives 37 inches in North Temperate, only 26 in South Temperate Zone, annually.—Johnston.

† Letter to Lord Wrottesley, read before the "British Association," Session of 1860.

‡ Mary Somerville states another ground for supposition of a mild circumpolar Arctic climate:—"The pole of the earth's rotation is nearly midway between the two poles of maximum cold (one 79° latitude, 120° E. longitude, and the other near Melville Island), and a line joining these two points nearly coincides with the bisection of the polar basin, through its two great outlets, into the Pacific and Atlantic oceans—a feature strongly indicative of the absence of land, and of a milder climate, in the polar ocean."—"Physical Sciences," Section xxv., 9*th Edition*.

The poles of maximum cold in the southern hemisphere not ascertained.

Another significant fact indicative of a mild polar climate is, that the warmer winds of extreme northern regions blow from N. and N. E.,—suggesting the probability that the heated air of the Torrid Zone, ascending, flows to the Pole; whence, after precipitating its moisture, it ebbs in refluent currents through the lower atmosphere; and a similar conjecture may apply to the Antarctic question also.—J. L.

tinctly-developed oceanic passages through the icy annulus have been yet discovered; while the Arctic basin discloses the great outlets of Baffin, and the Hudson and Greenland seas; and Kane, in his sledge-expedition, reports an open sea at 82°, with a temperature of 36°, and seals and water-fowl sporting on the surface.

On comparing the extent of the unexplored regions, we find the Antarctic area to be nearly twice the size of Europe; whereas the unexplored Arctic area is scarcely as large as Europe. Within such vast spaces, there is ample room for many and various climes and climates.

That the unknown Antarctic is of continental form, as some conjecture, from the circumstance of land being generally antipodal to water, does not follow even on this admission; for the nature of the intra-Arctic region is not yet known; besides, an unvaried terrene area must cause a climate of perpetual congelation, where the annual increments of snow and ice would so enormously exceed the decrement from evaporation alone, that, in as few score years as Adhèmar's theory estimates thousands, the oblateness of the sphere at the pole would be transformed into a cone of such immense dimensions and gravity, as to displace the centre of gravitation, and evagate the axis of the globe;* so that the Austral ocean would be poured in one wide whelming deluge over all the inhabited globe. But the earth has remained stable for 4,000 years; and each time the rainbow spans the sky, we are reminded of the Divine assurance, that "the waters shall no more become a flood to destroy the earth." The intra-Antarctic area, therefore, is not a continent; neither is its conformation that of a mediterranean ocean, zoned with a lofty cincture of snow-clad mountains, like a vast atoll, with its central lagune sea; for that would be contrary to all analogies of geographical contour, and, besides, must eventuate in periodical cataclysms or overflows, such as have never occurred in the history of telluric revolutions. Similar inferences are applicable to the inter-Arctic area; and it is therefore conjectured, that both are archipelagoic in character†—water bearing larger proportion to land in the Antarctic than in the Arctic regions, in order to compensate by a consequent milder climatical constitution for the eight days longer winter, and so sustain the sphere unchanged in its balanced gravity, temperature, and motions. Captain Maury argues for the continental formation of the Antarctic regions, which

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* I have read somewhere a singular Chinese tradition of the north star having sunk suddenly towards the horizon, at a period coincident with our era of the Noachic deluge. A tilting upwards of the earth's axis would account for such a phenomenon, and for the consequent overflow of the boreal seas.—J. L.

† "There do not appear to be sufficient grounds to justify the assertion, that the various patches of land discovered by American, French, and English navigators, on the verge of the Antarctic circle, form a great southern continent. The boundary of the largest, Terre Adelie, has not been traced more than 300 miles; Enderby's Land, not exceeding 200 miles; the others being mostly of inconsiderable extent, and of somewhat uncertain determination, with wide channels between; which leads rather to the conclusion, that they form a chain of islands."—J. C. Ross, vol. i., c. 9. See, also, Plate VI.

also he supposes to abound in lofty mountains and volcanoes, so as to account for the excessive precipitation; but then such a configuration cannot co-exist with a mild climate.

The probability once admitted, that these regions are habitable, imagination leaps instantly to the conclusion, that they teem with organic life, animal and vegetable—the sphere of Antarctic being, so long isolated from the plastic domination of civilized man, presenting, it may be, the strange and monstrous features of some former geological era, analogous to the Fauna and Flora of Australia and New Zealand. Thence to the savage biped, unfledged, is but an easy step.—Occasionally, though at long intervals, polar seas appear to undergo a thorough break-up in some unusually warm summer, and from other unexplained causes; for instance, in 1832 the Austral waters were covered with such a vast fleet of bergs—many of them literally glaciers afloat—that the navigation round the Horn was interrupted, and mariners were obliged to put back to Valparaiso and the River Plate. At such a conjuncture, an islander, in his canoe, being drifted through the opened sluices to intern climes, involves no stranger improbabilities than the peopling of the islands of the Pacific, many of which are separated by distances of 5000 miles; and yet the inhabitants, in form, habits, and especially in structure of language, present a certain identity of type, betokening unity of origin.* What these Antœcians of the Esquimaux are like, it is vain to conjecture—whether enveloped in skins, like their Arctic congeners, or thatched, like some of the Chinese tribes; but probably the adventurous navigator, who first stumbles on them, will not be more astonished than Gunbiorn was, 900 years ago, at the outlandish Esquimaux, or than Columbus, five centuries later, when the lithe and feather-crowned Charib beckoned his dispirited crews to the pleasant shores of Guanahani. Doubtless, we shall be hearty in congratulating the successful explorer on his safe return, and curious to hear his report, though not having the least desire ourselves to make such frigid acquaintances. And, should our gracious monarch ever be proclaimed Queen of the Terra Antarctica, I most devoutly trust, that no persuasion of her Majesty's ministers, nor loyal addresses from her Antarctic subjects, will induce her Majesty, or any of the royal Princes, to visit that remotest portion of "the outer Britannic Empire."

I thank you for tolerating these playful allusions; and yet they are not unimportant, even in their very lightness, if they lead our reflections to the consideration, to which I would, in conclusion, solicit your kind attention—*namely*, What advantages, scientific, commercial, social, are legitimately to be expected from the accomplishment of the daring feat—hitherto vainly attempted, sometimes disastrously defeated—of overpassing these icy barriers, and penetrating to the poles of our planet?†

* "Cook's Voyages"—Appendix.

† The inquirer is referred to Maury's sanguine views of an Antarctic Expedition, sections, 876–8, &c., &c., 8*th* *Edition* of "The Physical Geography of the Sea" (publisher, Sampson Low). The proof-sheets (kindly furnished to me some weeks before

The chief scientific objects to be expected from polar researches—omitting all vague guesses at matters unknown to experience—are connected with astronomy, magnetism, and the geographical features of the oblate sphere.* To look upon the summer sun steadfast above the horizon, and during the long night of winter to gaze upon the moveless firmament, from a position unaffected by the diurnal rotation of the globe—and that there is such a spot, is mathematically certain—present a vantage-ground of observation, involving many curious additions to human knowledge, respecting the movements and phases of the planets, and the libration of our satellite, the cause or causes of terrestrial magnetism, and the configuration and geological structure of the polar depressions. There the principal phenomena of time and space appear under novel conditions and aspects, and must be re-cast in broader measurements,—compelling our polar residents (who will walk the earth with a firmer tread, as the centrifugal counteraction retires towards its vanishing point) to interpret, with an extended application, the Mosaical description of "the lights that rule the day, and that rule the night."—Such appear to form the chief grounds of expectation for scientific discovery, dependent, however, on a clear sky, undimmed by those fogs and clouds which are supposed to hang continuously over polar climes. Without a clear sky, the astronomer's occupation is gone; and those who dwell under an ever-impending mist cannot behold the starry sphere in its unshrouded glory.

As for commercial benefits, the intra-Antarctic seas, even if found practicable for navigation, do not lie in the direction of any desiderated track; and the Arctic passage is little thought of, since steam and the great circle routes† have bridged the many-termed ocean; and given winds, and waves, and currents, previously the terror and obstacles of the mariner, to be his chosen allies, and faithful ministrants of his will. Again, the existing trade, and its possible extension in these extreme latitudes, may be enumerated in three divisions—the peltry trade, products of the Whale and Seal tribes, and the metals and coal. As to the first, the fur-bearing land animals, not found at all in the Antarctic,

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publication) were read to the meeting, before I presumed to express dissent from some of Captain Maury's conclusions. This enlarged edition is probably the most interesting scientific work ever published,—displaying vast and varied stores of knowledge, gathered with unparalleled industry, and clothed in language of the richest poetic structure.—J.L.

* Galileo states in his Dialogo, "that the parallelism of the earths's axis is maintained by a centre of magnetic attraction existing in space." But, whether this mysterious power has its source in the sun, or within the womb of starry distances, science must wait long to determine.—J. L.

Alexander V. Humboldt quotes a curious instance of morbid imagination (Kosmos, vol. i., 161)—"Near the North Pole, in 82° latitude, an enormous opening is imagined, from which the polar light, visible in auroras, streams forth, and by which a descent into the hollow sphere may be made. Sir H. Davy and myself were repeatedly invited by Captain Symmes to undertake this subterranean expedition."

† Maury's "Physical Geography of the Sea," c. 18.

decrease northward in high Arctic latitudes; and if the Greenland Whale and his congener of the Austral Oceans* were tracked to their breeding-places, which are conjectured to be situate in the remote polar recesses, guarded by nature from human intrusion by the encircling icy ramparts, I verily believe, that whole division of the cetaceous family would soon become extinct under the insatiable cupidity of the trader; for the only never-failing method of destruction is to harpoon the cub, the vehement love of offspring inherent in the whale rendering it then an easy prey. The loss of cetaceous products might perhaps be repaired by increased supplies of vegetable oils and ligneous fibre; but what remedies could be applied to the injurious effects in the economy of ocean life and salubrity, resulting from the extinction of the animal itself? As to the third branch of productions; copper and coal exist in abundance in the Arctic regions, but hitherto the risk and cost of procurement and transport have precluded appropriation to commercial uses;† even the reduction of auriferous substrata in many localities of northern Siberia seldom yields a profit to the miner, though he has little else to do than to quarry the frozen clods a few feet beneath the surface, and melt them, in order to obtain the pure granular metal; and how much less probability of the metals of far higher latitudes ever repaying labour and carriage!

In short, to close with a social view of the question, extreme cold on lofty elevations, or in high latitudes, appears to be the one insuperable obstacle to a complete subjugation of the earth to human service and wants; and the dwarfed stature, and mental and moral degradation, of the Fuegians in the southern, and Esquimaux in the northern hemisphere, alike attest the irrefutable conclusion, that man cannot dwell in the fulness of his attributes, nor exercise his delegated dominion over material nature, in presence of the power of extreme cold—"Who can stand before His cold"?‡ (Psalm cxlvii. 17.)

Sitting by my own fireside, I have travelled right pleasantly with Cook, Wilkes, Kane, Ross, D'Urville, and other brave adventurers, across inhospitable deserts, and through the berg-strewn oceans of austral and boreal climes; the few observations laid before the Society this evening, however inadequately reasoned, have been eliminated with diligence and care; and apparently justify the probability, that a comparatively

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* These are different animals. They never cross the tropics; the warmer ocean being to them as a sea of fire.—Maury's "Physical Geography of the Sea," c. 8.

† No valuable mineral has yet been found, nor is any likely to be discovered, in *Antarctic* lands. In West Greenland some British mining operations have been of late years carried on with dubious success. The eastern shore ("lost Greenland"), which has been ice-blocked for centuries, if ever again reached, may afford better hopes from its more convenient geographical position. Esquimaux gossip tells of abundant mineral treasures on that coast; and Giesecké's collections in London and Edinburgh, as well as in the Museum of this Society, contain some curious, though very few valuable specimens,—practically useless, however, from not being distinctively localised.—J. L.

‡ The original Hebrew, and the Septuagint, are emphatically expressive of the extended meaning, I have ventured to apply to this passage.—J. L.

mild climate prevails in unreached circumpolar regions, both of the southern and northern hemispheres; but that the frozen cordons, circling these central spaces, are of such extent and inclement temperature as to render ingress impracticable, and to present only to the enthusiasm of discovery "that bourne whence no traveller returns."

The conclusions (unanticipated, indeed unstudied, when my friend, Captain Maury, called my attention to the subject), to which my mind is irresistibly led, are, that all the advantages, resulting from polar travel from the earliest time to the present, are incomparably outweighed by the single enterprise (even in its partial accomplishment), of Livingstone in Africa,—that any prospective benefit, reasonably expectant on the continuance of these expeditions, are not of such value as to compensate the risk of human life, and loss of time and of material,—and that the governments of Great Britain, the United States, Holland, Russia, and France, who have hitherto embarked the pioneers of polar discovery, are not justified in affording aid or sanction to any future exploration; but that they should leave these impracticable and irreclaimable regions to the whaler, the hunter, and the zealous worshipper of science whose enthusiasm leads him to neglect the lessons of experience; conceding governmental sanction exclusively to such exploratory enterprises, as promise reproductive returns in their moral and physical consequences.

There are continents, yet scarcely known, except in isolated spots upon their geographical boundaries, and many districts of vast extent and capabilities, especially in the dominions of Great Britain, Holland, and the United States, where the scattered inhabitants are as uncultured as those deserts, in which they waste an aimless and uncertain life. Within this category lies the legitimate domain of discovery, where England and the great Western Republic—scions of the same ascendant race—may strive—I do not say in emulation, for that is too often a softer synonyme for strife, but, shoulder to shoulder, in faithful partnership, to plant the banner of Christian civilisation, and reap the harvests of climes as yet unappropriated by industrial enterprise; thus demonstrating the verity of that grand social problem—that an international federation of philanthropy and commerce constitutes the most powerful instrumentality of progress, of which humanity is capable in this our era.

Calm reflection, withdrawn from the influences of enthusiasm, deals rather with results of acts than with motives of the actors; and, while sympathising, in all respect and sincerity, with the aspirations of the brave and unselfish volunteers of discovery, I would venture to apply to the general subject of polar research the deliberate judgment, pronounced nearly a century since on the Antarctic question by a celebrated navigator, whose zeal, experience, and intrepidity have never been surpassed—"I flatter myself" (writes Captain Cook, after his last voyage), "that the southern hemisphere has been sufficiently explored, and a final end put to the searching after a southern continent, which has engrossed the attention of maritime powers for nearly two centuries, and been a favourite theory amongst the geographers of all ages." . . . . . .
"However, if any one should have resolution and perseverance to clear

up this point, by proceeding further than I have done, I shall not envy him the honour of the discovery; but I will be bold to say, that the world will not be profited by it".*

XII.—Letter from Mr. John T. Bagot, Crown Land Commissioner, South Australia, describing some recent important Discoveries in Central Australia.

Crown Lands' Office, Adelaide, South Australia, October 27th, 1860.

Sir—It affords me great pleasure to be enabled to inform you that Mr. J. MacDugald Stuart, a colonist of many years' standing, formerly the companion of Captain Sturt in his spirited expedition into the interior of this colony, and since distinguished by his undaunted energy in penetrating to its hitherto unexplored regions, has, after a journey unexampled for its speed and the largeness of its results, when compared with the smallness of the means at his disposal, succeeded, not only in reaching the centre of this continent, but in solving the problem so long a matter of mere speculation, by virtually crossing the vast interior of New Holland.

Starting in April last, from "Chambers' Creek," which is situated about five hundred miles to the north of Adelaide, and is one of his own former discoveries, Mr. Stuart visited the centre of Australia, and planted a flag on the summit of a considerable range of hills, to which he gave the name of "Central Mount Sturt," thus exploding the theory so long entertained by men of the highest scientific attainments, that the centre of Australia was a depressed basin. Having accomplished this feat, he pressed forward with his little party (consisting of but two companions and himself, with thirteen horses), and boldly pushed through the vast and unknown interior, until he reached lat. 18° 57′ S. and long. 134° E., thus overlapping, by one hundred miles, the point to which Gregory had penetrated, when proceeding southwards down the Victoria River.

During the entire extent of this wonderful trip, Stuart met with fine grassy plains, well watered, and intersected by ranges of not a lofty character; the extreme distance he had to travel without water was about sixty miles.

Unfortunately for the cause of science, when our explorer had reached the latitude mentioned, viz., 18°57′, he was met by a tribe of hostile natives, who attacked him in the most savage and determined manner, and, after the exercise of great forbearance on the part of Mr. Stuart, were eventually driven off only by the loss of some of their number. On account of the smallness of his party (all the members of which had been weakened by attacks of scurvy), the gallant Stuart was

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* "Voyages," Vol. ii., c. 7.

at length compelled reluctantly to retrace his steps; and, with his two companions, regained in safety the abode of civilized man, much exhausted, indeed, through illness and privation, but unbroken in spirit, and ready immediately again to encounter the difficulties and dangers inseparable from such an enterprise.

You will see that Stuart, in this expedition, reached to within about two hundred miles of the Victoria River, and to about the same distance from the Gulf of Carpentaria. He was compelled to turn back, when in the midst of a well-watered country; and, had it not been for the overpowering attack made upon him by the natives, would assuredly have succeeded in reaching the sea-coast to the north of this colony. In the course of his expedition, Stuart discovered many curious plants; and a tree that he met with (which I believe to be the Baobab Tree) he describes as being something splendid—his whole party of three men, and thirteen horses, having rested under its shade. Mr. Stuart brought back some of the fruit, which grows in a pod, similar to that of our common bean.

Stuart's journal and map will be published in the course of a few days. In the meantime, the Government of South Australia have lost no time in fitting out an expedition of twelve men—to be provided with forty horses—that the journey so nobly commenced by Stuart may, by him, be successfully completed. I expect this party to start from Chambers' Creek in about four weeks, and that it will be the first to traverse the Australian Continent from sea to sea. The success of this exploit will, I trust, materially assist in developing the resources of this our province of South Australia, and enable us to ship our horses to India from the banks of the Victoria River. Of all advantages, however, to be derived from such a discovery as the present, the most sensible, perhaps, will be, that an overland telegraph wire can be at once run through a country abounding in timber fit for the construction of such a line; thus almost entirely obviating the difficulties and hazard of submarine communication, and establishing an intimate connexion between Old England and her remote, but flourishing, colonies in these waters. I enclose herewith a small portion of "Gelatine," brought back by Stuart on his return to Adelaide, as a specimen of the diet upon which he and his two comrades were sustained during their arduous excursion.

I have given you this rather extended statement of Stuart's journey, feeling confident that the members of the Royal Dublin Society—who ever take such a deep interest in all matters connected with the advance of geographical science—will receive with pleasure this account of a journey so perilous, so nobly conceived, and so bravely carried out. I should mention that the expedition from which Mr. Stuart has just returned was fitted out by, and at the expense of, one of our oldest colonists, Mr. James Chambers.

I am, Sir, your very obedient humble servant,

JOHN T. BAGOT.

W. E. Steele, Esq., Secretary to the Royal Dublin Society, Kildare-Street, Dublin.

XIII.—On some further Applications of the Ferrocyanide of Potassium in Chemical Analysis. By Edmund W. Davy, A. B., M. B., M. R. I. A., Professor of Agriculture and Agricultural Chemistry in the Royal Dublin Society.

[Read before the Royal Dublin Society, December 17, 1860.]

I have recently been engaged in making some experiments on the ferrocyanide of potassium, or yellow prussiate of potash, with a view to extend its applications in chemical analysis; for though this important salt has already been applied to a number of useful purposes in analytical research, still my experiments have shown me that its use might be advantageously extended, particularly as a reagent in volumetric analysis,—a form of analysis which has of late come into very general adoption, especially for technical purposes, on account of the great quickness, and at the same time accuracy, with which different substances may by its means be determined. The principles upon which volumetric analysis depend are so well known, that I need not refer to them; and, though it possesses so many advantages over the older gravimetrical method, in which the different substances are determined by weight, instead of by volume, has, however, this drawback, that the preparation of the necessary standard solutions often takes considerable time: first, in order to obtain the substance to be used for this purpose in a sufficiently pure and dry state; and, secondly, the forming a solution of it the exact strength of which may be known. For though it may appear a very simple operation to dissolve a known weight of a certain substance in a given bulk of water, or other solvent, yet where this has to be done with such great precision as is necessary in those cases, it is a tedious and troublesome operation, and any inaccuracy in the graduation of the standard solution will render all determinations made with it more or less inaccurate. It is obvious, therefore, that it would be most desirable that the substances which are intended to be used as reagents in volumetric analyses should be easily obtained in a pure state, and that when considerable time and trouble have been expended in graduating solutions of those substances, they should not be liable to undergo changes whereby their strength would be more or less altered; but that, when standard solutions have once been made, they might be kept and used for a great number of determinations.

The ferrocyanide of potassium fulfils both those conditions; for it is in general met with in commerce almost chemically pure, and in a state in which it can at once be employed as a volumetric reagent; and if at any time it should happen to occur not quite so pure, it can readily be purified by recrystallization; and, in addition to these important considerations, its solution is not prone to change, especially if it is not left exposed to the action of the light. In this latter respect it has a decided advantage over several of our most useful volumetric reagents, viz., the permanganate of potash, the protosalts of iron, sulphurous acid, &c., which, from their being so prone to undergo spontaneous decomposition,

must be either freshly prepared, or the strength of their solutions be accurately ascertained every time they are used, if a day or so has elapsed between each determination.

The employment of the ferrocyanide of potassium as a volumetric reagent depends on the following circumstances, viz., that it is readily converted into the ferridcyanide of potassium (red prussiate of potash) under different circumstances, and that the point where the whole of the former salt has been changed into the latter may easily be known, either by the use of a diluted solution of a persalt of iron (which gives with a drop of the mixture a blue or green colouration, as long as any of the ferrocyanide remains unchanged), or by some other simple indication. Thus, for example, when chlorine is brought in contact with the ferrocyanide of potassium, this change, as is well known, takes place, which is expressed by the following symbols:—$2(K_2,FeCy_3) + Cl = (K_3Fe_2Cy_6) + KCl$.

The same occurs as far as the conversion of the ferrocyanide into ferridcyanide, when an acidified solution of the former salt is brought in contact with a solution of the permanganate of potash, which is instantly decolorised by the reducing action of the ferrocyanide of potassium, which is thereby converted into the ferridcyanide, and this decoloration of the permanganate continues as long as any of the ferrocyanide remains in the mixture.

Again, if a solution of the ferrocyanide of potassium, acidified strongly with either hydrochloric or sulphuric acid, be brought in contact with a solution of the bichromate of potash, the same change of the ferrocyanide into the ferridcyanide immediately takes place.

The first reaction has been long known, and is the means employed at present for obtaining the ferridcyanide, or red prussiate of potash, for manufacturing and other purposes; the second reaction has been more recently discovered; but I am not aware that the third, in the case of the bichromate, is generally known, or that the changes which occur in the reaction have been previously studied.

From experiments which I made, it would appear that when a solution of ferrocyanide of potassium, acidified with hydrochloric acid, was mixed with one of the bichromate of potash, the following reaction was produced, viz.:—$6(K_2FeCy_3) + KO, 2CrO_3 + 7HCl = 3(K_3Fe_2Cy_6) + 4KCl + Cr_2Cl_3 + 7HO$; for, amongst other facts, I may observe, that when I mixed together solutions of the two salts in the proportions corresponding to six equivalents of the ferrocyanide of potassium to one of the bichromate of potash (as indicated in the above formula), acidifying the mixture with hydrochloric acid, I found that the whole of the ferrocyanide was converted into the ferridcyanide, and that any quantity less than that proportion of the bichromate of potash left more or less of the ferrocyanide unchanged. The same results followed the use of sulphuric acid; and it appears that a similar reaction occurs with this acid as with hydrochloric acid, with the exception that in this case the 4 equivalents of chloride of potassium and the 1 equivalent of sesqui-chloride of chro-

mium are replaced by 4 equivalents of sulphate of potash and 1 of the sesqui-sulphate of chromium.

The proportion of either acid used, provided there is enough to strongly acidify the mixture, does not appear to affect the reaction; for I obtained precisely the same results where a very large amount of acid was employed as where the quantity necessary only to strongly acidify the mixture had been added.

On those three reactions which I have noticed may be based the means of employing the ferrocyanide of potassium in several useful determinations; the first, and one of the most important of which, is *the ascertaining the amount of available chlorine in the chloride of lime, or bleaching powder*, which is a matter of much importance in many of the chemical arts, but particularly in bleaching; for not only does the commercial value of this substance depend on the quantity of available chlorine that it contains, which is subject to great variation, from exposure to the air and other causes, but likewise it is of the greatest importance that the bleacher should readily be able to determine from time to time the strength of the bleaching liquor which he employs; for if it be too strong, he knows that the fabric which he bleaches will be injured; and if too weak, it will not be sufficiently bleached, and the process must be repeated, which incurs much additional expenditure of time.

Various methods have, from time to time, been proposed for the determination of the value of chloride of lime; but the greater number of them, from the trouble required to make the test solutions, and their not keeping when made, as well as the skill required in their use, render them inapplicable for general purposes. I shall therefore merely refer to the two methods which are chiefly used at present to determine the value of this important substance. The first is Gay Lussac's, in which the amount of chlorine is ascertained by seeing how much chloride of lime is necessary to convert a given quantity of arsenious into arsenic acid; the second is Otto's, in which protosulphate of iron is substituted for arsenious acid, and the determination of chlorine is made by seeing how much of the bleaching powder is required to change a given weight of the protosulphate of iron into a persalt of that metal; these processes are so well known, that I need not describe them.

In both these methods I find that more or less chlorine is always lost, which, however, may be reduced to a minute quantity by very carefully adding the solution of chloride of lime to that of either arsenious acid, or of protosalt of iron; but in general hands they (especially the latter process) will yield results in which too small a proportion of chlorine will be indicated, from the loss of that substance which will invariably take place.

The ferrocyanide of potassium answers admirably for the estimation of available chlorine in the chloride of lime, when used in the manner I shall presently explain, and, according to my experiments, will give in general hands far more accurate results than either Gay Lussac's or Otto's method. I am aware, however, that this salt was proposed by Mr. Mercer

some years ago for this purpose; but the way which he recommended it to be used, which consisted in dissolving a certain weight of ferrocyanide in water, acidifying it, and then adding the solution of bleaching-powder from a burette, till all the ferrocyanide was converted into ferridcyanide, is I find not a good manner of employing the ferrocyanide in this estimation, and, like the other methods, will lead to a loss of chlorine; for when the solution of chloride of lime is added to the acidified ferrocyanide, a portion of the chlorine is separated, especially if the bleaching liquor be added too quickly, or is not greatly diluted. But the way I propose of using the ferrocyanide of potassium in this important valuation is to mix together a certain quantity of a standard solution of ferrocyanide with a given amount of a graduated solution of the chloride of lime, using more of the former salt than the latter can convert into ferridcyanide; then adding hydrochloric acid, to dissolve the precipitate formed, and render the mixture strongly acid; and finally ascertain, by means of a standard solution of bichromate of potash, how much of the ferrocyanide remained unconverted into the ferridcyanide by the action of the chlorine of the chloride of lime, which is effected by adding, slowly, from a graduated burette, the standard solution of bichromate till a minute drop, taken from the well-stirred mixture, by means of a glass rod, ceases to give, with a small drop of a very dilute solution of perchloride of iron, placed on a white plate, a blue or greenish colour, but produces instead a yellowish brown.* When this latter effect is observed, it indicates that all the ferrocyanide has been converted into ferridcyanide; and as 147·59 (one equivalent) of bichromate of potash is capable of converting 1267·32 (six equivalents) of crystallized ferrocyanide of potassium into ferridcyanide; and as 422·44 (two equivalents) of the ferrocyanide are converted into the same substance by 35·5 (one equivalent) of chlorine, as is seen by the formulæ already given; knowing the amount of chloride of lime employed, we have all the data necessary to calculate the per-centage of chlorine.

Having made two standard solutions, the first containing 21·122 grammes of ferrocyanide of potassium in a litre of the solution, and the second 14·759 grammes of bichromate of potash in the same quantity of solution (weights which are to each other as their atomic equivalents), I made several estimations of chloride of lime with them, adopting the method I have just described, and found that it gave the most consistent results, and which agreed very closely with those obtained by Gay Lussac's and Otto's method, when the latter were performed with the greatest care,—the only difference being, that the results obtained by my method indicated a few hundredths of a part more of chlorine than either of those

* The yellowish-brown coloration, which is at first produced when enough of the bichromate has been added, quickly changes to a greenish colour by some secondary reactions, which take place when the persalt of iron is left in contact with the mixture; but this does not interfere with the test; for it is the first effect that is produced which indicates the completion of the reaction, and not the after-changes which may result.

methods did, which may be accounted for by the unavoidable loss of a minute quantity of chlorine which takes place in those processes.

In order to simplify the process, and render the calculation as short as possible, I would recommend, for commercial valuations, the following way of carrying out this principle:—

Having obtained a flat-bottom flask, or bottle, which will contain ten thousand grains of distilled water, when filled up to a certain mark in the neck, make two standard solutions—the first, by placing in the flask, or bottle, 1190 (or exactly 1189·97)* grains of the purest crystallized ferrocyanide of potassium (yellow prussiate of potash) reduced to powder, adding distilled water to dissolve the salt, and, when this is effected, filling up with water to the mark; and having mixed the solution thoroughly, place it in a well stoppered-bottle. The second standard solution is made in the same manner, substituting for the ferrocyanide 138·6 (or exactly 138·58) grains of bichromate of potash, which has been purified by re-crystallization, and fused in a crucible, at as low a heat as possible. Both these solutions will keep unchanged, and will answer for a number of determinations, if they are preserved in well-stoppered bottles, and the ferrocyanide solution be kept, when not in use, excluded from the light. Get a burette, or alkalimeter, capable of holding or delivering 1000 grains of distilled water, and divided into 100 equal divisions; also two small bottles, one capable of delivering 1000 grains, and the other, 500 grains of distilled water, when filled up to a certain mark on the neck of each,† which may both be readily made by filling them with water, emptying them, and, after they have drained for a minute or two, weigh into each the above weights of distilled water; or, what will be sufficiently accurate for most purposes, pour from the burette into one, 100 divisions of distilled water, and into the other 50, and mark with a file where the fluid stands in the neck of each bottle. Having these all ready, take an average specimen of chloride of lime, and weigh out 100 grains of it, and make in the usual way a solution of it, by trituration in a mortar with some water; and, pouring it into the flask which was used in preparing the two standard solutions, and having filled up with water to the mark in the neck, mix the solution thoroughly, and before each time any of the chloride of lime is taken out, shake well the contents of the flask. Measure out into a beaker glass, by means of the two little bottles, 100 divisions of the chloride of lime solution, and 50 of the standard solution of ferrocyanide; and, having mixed them well together, add some hydro-

* The above numbers are obtained as follows:—35·5 parts of chlorine are capable, as before stated, of converting 422·44 parts of the crystallised ferrocyanide of potassium into ferridcyanide; therefore, 100 parts of the former will convert 1189·97 parts of the latter into the same compound. Again, as before observed, 1267·32 parts of the crystallized ferrocyanide require 147·59 of the bichromate of potash to convert them into the ferridcyanide; 1189·97 parts, therefore, will take 138·58 parts of that salt to produce the same effect.

† Two small pipettes, capable of delivering the above quantities, would be found still more convenient.

chloric acid, to dissolve the precipitate formed, and acidify the mixture strongly, and having mixed the whole well, pour from the burette slowly the standard solution of bichromate (stirring well all the while) till a drop, taken from the mixture and brought in contact with a drop of a very weak solution of perchloride of iron, produces a yellowish-brown colour, as already noticed. Then read off the number of divisions of the standard solution of bichromate which was necessary to produce this effect, and this, being deducted from 50, gives the percentage by weight of chlorine.

For the standard solution of ferrocyanide having been made, so that the 10,000 grain-measures should be equivalent to 100 grains of chlorine, and as every division of the burette equals 10 grains, each of these divisions of the ferrocyanide solution, converted into ferridcyanide, will indicate 0·1 grain of chlorine; again, the 100 divisions of the solution of chloride of lime represent 10 grains of that substance, and we want to know how many divisions of the ferrocyanide solution its chlorine has converted into ferridcyanide? this is readily ascertained by the bichromate solution, which has been so graduated that each division represents a division of the ferrocyanide solution.

So that, to determine the percentage of chlorine, we have only to deduct, as before stated, the number of divisions of the bichromate solution employed from the 50 of the ferrocyanide solution, and the difference gives us the percentage of chlorine, by weight, in the sample; thus, in four experiments, 50 divisions of the ferrocyanide solution, mixed with 100 divisions of the solution of chloride of lime, required 18·5 divisions of the bichromate solution to convert the whole of the ferrocyanide employed into ferridcyanide; this number, taken from 50, leaves 31·5 divisions of ferrocyanide, which were converted into ferridcyanide by the chlorine of the chloride of lime; and as each division represents 0·1 grain of chlorine, 31·5 will be equivalent to 3·15 grains of chlorine, which is the amount contained in 10 grains of the sample; consequently, 100 grains will contain 31·5 grains of chlorine, which is the same amount as is obtained by simply deducting the number of divisions of bichromate solution employed from 50 of ferrocyanide used in the estimation.

Though this process appears a long one, from the details which are necessary to explain its principle, yet in practice it is very expeditious, and requires only a very few minutes for its performance, and is much quicker than either Guy Lussac's or Otto's method.

Though I have as yet chiefly confined my attention to the use of the ferrocyanide of potassium in the estimation of chlorine in bleaching powder, I have no doubt but that it may be advantageously employed in many other useful determinations, by carrying out the principles already explained; thus, for example, it may be used as a means of determining the amount of bichromate of potash present in a sample of that salt, or the quantity of chromic acid that exists under different circumstances. Again, the same salt may be used in different determinations where a certain amount of chlorine is liberated, which represents a pro-

portional quantity of some other substance; thus, for example, in the estimation of manganese ores for commercial purposes, where they are heated with hydrochloric acid, the quantity of chlorine disengaged will indicate a certain amount of peroxide of manganese in the ore, on the presence of which its commercial value almost entirely depends; and the chlorine evolved may be estimated by absorbing the gas in a dilute solution of caustic potash, and then determining the amount of chlorine in it by precisely the same process as that I have recommended in the valuation of chloride of lime. To test the accuracy of this method, I heated in a small flask a given quantity of pure bichromate of potash with an excess of strong hydrochloric acid, and collected the evolved chlorine by means of a dilute solution of caustic potash, employing the bulbed retort and curved dropping-tube, as recommended by Bunsen in the analysis of chromates,* and ascertained afterwards by the use of the ferrocyanide of potassium the amount of chlorine evolved, which corresponded almost exactly with the calculated amount of that substance which should have been obtained by the action of the quantity of bichromate used on the hydrochloric acid. Again, a standard solution of ferrocyanide of potassium may be used, as E. de Haen has shown, to determine the strength of the permanganate of potash in the analysis of the ferrocyanide and ferridcyanide of potassium, as an acidified solution of the ferrocyanide, as before stated, rapidly decolorises a solution of permanganate of potash, whereas the ferridcyanide has no action on that salt, and this reaction might be taken advantage of in the valuation of chloride of lime, to determine the excess of ferrocyanide used in my process; but, from my experiments, I found that more precise and accurate results were obtained by the use of the bichromate of potash.

The reaction of the bichromate of potash on the ferrocyanide might be employed in the valuation of the ferrocyanide of potassium and other ferrocyanides, having previously, in the case of those which were insoluble, converted them into the ferrocyanide of potassium, by boiling them with caustic potash, and separating the insoluble oxides by filtration.

It might also be employed for the valuation of the commercial red prussiate of potash, which is now to some extent employed as a bleaching agent in calico printing, and which consists of varying quantities of ferro- and ferridcyanide of potassium, together with chloride of potassium, by ascertaining first how much a given quantity of the sample requires of a standard solution of bichromate of potash to convert the ferrocyanide present into ferridcyanide, the percentage of that substance would be known; and then, by taking another portion of the sample, and converting the ferridcyanide it contained, by reducing agents, such as the sulphite of soda and potash, &c., into the ferrocyanide, and finally determining the amount of bichromate necessary to bring the whole of the ferrocyanide then present into the state of ferridcyanide, the difference in the two results would indicate the proportion of ferridcyanide originally present in the sample.

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* See the last edition of Fresenius's "Quantitative Analysis," p. 234.

The last application of ferrocyanide of potassium which I shall notice in the present communication, is its employment as a reducing agent. It has long been known that the cyanide of potassium possesses most powerful reducing properties, and has been very usefully employed for that purpose in the reduction of different metallic salts, under various circumstances; but I am not aware that the ferrocyanide of potassium has been proposed or used for similar purposes; at least, I have referred to a great number of analytical and general chemical works, and in none of them is this salt recommended as a reducing agent, though the cyanide is so much extolled for that purpose. According to my experiments, the ferrocyanide is a far more convenient reducing agent than the cyanide, and may be substituted for it in many cases of reduction with the best effects, as it possesses many unquestionable advantages over that salt for this purpose; thus, the ferrocyanide does not deliquesce and decompose when exposed to the air, whereas the cyanide rapidly absorbs moisture, and, unless kept in very well stoppered bottles, becomes quite wet, and in this state quickly decomposes; and this deliquescence on the part of the cyanide is often a source of much inconvenience in its use as a reducing agent, owing to the almost unavoidable absorption of more or less moisture which takes place in mixing it with the substance to be reduced, and the introduction of the mixture into the reducing tube. The ferrocyanide, on the other hand, in a thoroughly dried and finely powdered state, can be intimately mixed with the substance without any appreciable absorption of moisture. I made the following comparative experiment, to ascertain the relative absorptive properties for moisture of the two salts under the same circumstances. Having thoroughly dried, in a water-oven, till it ceased to vary in weight, some finely-powdered ferrocyanide, I placed 50 grains of it in a counterpoised watch-glass, and, powdering in a warm mortar some fresh cyanide of potassium, I placed the same quantity of it in a similar counterpoised watch-glass, and left them both exposed to the air. On examining them, after four hours' exposure, I found that the former had only gained the $\frac{6}{100}$th part of a grain of moisture, whereas the latter had taken up 3·6 grains, or sixty times as much moisture, under the same circumstances. After two days' exposure, I found that nearly all the cyanide had passed into the liquid condition, having taken up 46 grains of water, whereas the ferrocyanide appeared perfectly dry, and had only absorbed 1·4 grains.

The great fusibility of the cyanide is sometimes rather a disadvantage, which has to be lessened by mixing it with a certain proportion of dried carbonate of soda; but the ferrocyanide, not fusing at so low a temperature, does not require, in most cases, this admixture to lessen its fusibility. Again, the ferrocyanide is not a poisonous salt; whereas the cyanide is highly so, and must be used with great caution; and, lastly, the former salt is little more than half the price of the latter. Combined with the above advantages, I find that the ferrocyanide is equally active in reducing metallic oxides and sulphurets, and is especially convenient for the reduction of different combinations of arsenic and mercury, which are reduced by it with the greatest ease.

I made several comparative experiments with the dried ferrocyanide

and with the cyanide as reducing agents for the sulphuret of arsenic and arsenious acid, employing the same quantity of arsenical compound with each salt under similar circumstances; and in almost every case, particularly where the quantities operated on were minute, I obtained more satisfactory results with the dried ferrocyanide than with the cyanide.

The following were amongst my experiments:—

I mixed the $\frac{1}{10}$th of a grain of sulphuret of arsenic with 3 grains of the dried ferrocyanide, and made a similar experiment, substituting the same quantity of cyanide; and, on heating the mixtures in a similar glass tube, obtained almost identically fine and characteristic rings of metallic arsenic.

I then intimately mixed the same quantity of sulphuret of arsenic with 49·9 grains of very finely powdered glass, and taking 5 grains of this mixture, containing the $\frac{1}{100}$th part of a grain of the sulphuret, mixed them with 5 grains of the dried ferrocyanide, and made a comparative experiment with another 5 grains of the mixture, substituting the same quantity of cyanide. On heating both those mixtures in small reduction tubes, I got the characteristic metallic rings in both; but better defined in the case of the ferrocyanide.

I finally took 2·5 grains of the mixture of sulphuret and glass, containing about the $\frac{5}{1000}$th part of a grain of sulphuret of arsenic, and treated them in the same manner, using in one case 2·5 grains of ferrocyanide, and in the other 2·5 grains of cyanide, and obtained in each case a minute metallic ring; which, however, was much more distinct and satisfactory where the ferrocyanide had been used as the reducing agent.

The same comparative experiments were made with arsenious acid, when results similar to those in the case of the sulphuret of arsenic were obtained.

The ferrocyanide, therefore, is a most delicate reducing agent in the case of arsenical compounds; and where very minute quantities have to be detected, appears, from my experiments, to give more satisfactory results than the cyanide.

Whether the addition of dried carbonate of soda would improve the ferrocyanide for some cases of reduction, I am not at present able to say; but in one experiment which I made with the sulphuret of arsenic, I obtained equally good results, using the ferrocyanide alone, as where it was mixed previously with its own weight of dried carbonate of soda. In many cases the ferrocyanide may be used as a reducing agent in a state of powder, without separating its water of crystallization; but in most cases it will be rendered a far better reducing agent by being previously dried at 212° in a water-bath or oven, and in this dried condition it may be kept for any length of time in a good stoppered or well-corked bottle.

Though as yet my experiments have been chiefly confined to the reduction of different compounds of arsenic and mercury, I entertain no doubt that the ferrocyanide of potassium will be found an equally effective reducing agent in the case of the combinations of other metals; and that it may with great advantage be substituted for the cyanide of potassium, in many cases where the latter salt is used as a reducing substance.

XIV.—On Two Associated Minerals from Ross Hill, near Maum, Co. Galway. By James Apjohn, M. D., Professor of Chemistry and Mineralogy in the University of Dublin.

[Read before the Geological Society of Dublin, December 12, 1860.]

In January, 1859, I received from Alexander Dickson, Esq., agent to Lord Leitrim, a box of rocks and minerals, and was requested by him to make such experiments upon them as would enable me to report upon the commercial value of each, and the mineral character of the district in which they were found. The specimens were collected by Mr. Dickson upon the townlands of Cleggan and Carrowgariffe, part of the Rosshill estate, situate in the mountain district of Connemara, lying between Lough Mask and Lough Corrib. The metallic minerals were few in number, and of a common kind, consisting of galena, the ordinary ore of lead, and of two compounds of sulphur and iron. One of these, which occurred in minute crystals, disseminated through quartz, was the well-known iron pyrites; the other was massive, slightly magnetic, and had adhering to, and dispersed through it, a green substance, resembling chlorite, and which, upon a qualitative examination, was found to be a silicate of the protoxide of iron.

Of the earthy minerals, there was but one having any claim to novelty, and it is to this that I venture to solicit the attention of this Society for a few moments.

This substance, which Mr. Dickson informed me was very abundant on Cleggan, had a curved, foliated structure, the laminæ of which it was composed not being parallel in masses of any size, but intersecting at various angles. Its colour was white, with occasionally a tinge of yellowish-green; its lustre pearly, and in very thin laminæ it was subtranslucent; its hardness was somewhat over 2, or a little higher than gypsum.

Before the blow-pipe it was nearly infusible, and it had the specific gravity of 2·802. Submitted to a careful analysis, it was found to have the following composition:—

Silex,	46·42	1·02	4
Alumina,	37·92	0·74	3
Peroxide of iron,	0·46		
Lime,	0·67	0·26	1
Magnesia,	0·17		
Potash,	9·63		
Soda,	1·54		
Water,	4·40	0·48	2
	101·21		

Upon discussing these results in the usual manner, they are found to conduct to the empirical formula

$$4\,SiO_3 + 3R_2O_3 + RO + 2HO,$$

R_2O_3 representing the alumina and peroxide of iron, and RO the combined amount of the alkalies and alkaline earths. From this it is easy to deduce the rational formula

$$RO, SiO_3 + 3(R_2O_3, SiO_3) + 2HO;$$

or, should we wish to avoid any hypothesis as to the manner in which the proximate constituents are arranged, we can write it

$$(\tfrac{1}{10}3RO + \tfrac{9}{10}R_2O_3)\,\tfrac{6}{5}SiO_3.$$

This latter method of representing in symbols the constitution of a mineral is becoming popular with mineralogists, as it takes cognizance of a fact, now pretty well established, viz., that protoxides and sesquioxides may replace each other; and also exhibits, by means of the coefficient attached to the silicic acid, the ratio between the amount of oxygen in the latter and in the basic oxides.

When I had completed this analysis, I was under the impression that I had fallen on a new and interesting mineral, having some general resemblance to talc, but differing from it in important particulars, being a little harder, and having a totally different composition,—containing, for example, but a mere trace of magnesia, the sole basic constituent of true talc, but, instead thereof, about 38 per cent. of alumina, and over 11 per cent. of mixed soda and potash. Before, however, announcing it as new, it became necessary to look into the books; and, having done so, I find mention made of several minerals which have some resemblance to that under consideration. A few of these minerals have been noticed by Thomson and Dana; but the most complete list of them occurs in the recent interesting volume, by Greg and Lettsom, on the Mineralogy of Great Britain and Ireland. The subjoined Table includes these different minerals, and, in addition, the Damourite of Delesse, a mineral found in Brittany, associated with Kyanite. The name of each mineral, its locality, and the name of the chemist by whom its analysis was made, is also given :—

TABLE I.

	Talcite, Wicklow (Tennant.)	Talcite, Wicklow (Short).	Gilbertite, Cornwall (Lehunt).	Gilbertite, Cornwall (Thomson).	Talcite, Three-Rock Mountain, Co. Dublin, (Haughton.)	Margarodite, St. Etienne (Delesse).	Margarodite, Connecticut (Brush).	Damourite, Brittany (Delesse).
Silex, ...	44·55	46·00	45·15	47·79	43·47	46·23	46·50	45·22
Alumina, . . .	33·80	35·20	40·11	32·61	31·42	33·08	33·91	37·87
Peroxide of Iron,	. .	. .	. .	. .	4·79	3·48	2·69	. .
Protoxide of Iron,	7·70	2·88	2·43	5·17	. .	. .	·82	trace
Protoxide of Manganese, ...	2·25	3·94	. .	. .	. .	. .	·31	trace
Lime, ...	1·30	9·61	4·17	. .	1·38	. .	. .	. .
Magnesia, . . .	3·30	. .	1·90	1·60	1·13	2·10	·90	. .
Potash, ...	. .	. .	. .	. .	10·71	8·87	7·32	11·20
Soda, ...	. .	. .	. .	9·23	1·44	1·45	2·70	. .
Water, ...	6·25	2·00	4·25	4·00	5·43	4·12	4·63	5·25
	99·15	99·63	98·01	100·40	99·77	99·33	99·78	99·54

Before comparing these minerals with each other, and with that from Connemara, it was desirable to calculate the empirical formula of each. This has been done, and the results are here subjoined:—

TABLE II.

Talcite, Wicklow (Tennant), . .	$6SiO_3 + 4R_2O_3 + 3RO + 4HO$.
Talcite, Wicklow (Short), . . .	$5SiO_3 + 3R_2O_3 + 2RO + HO$.
Gilbertite, Cornwall (Lehunt), . .	$6SiO_3 + 5R_2O_3 + 2RO + 3HO$.
Gilbertite, Cornwall (Thomson), .	$10SiO_3 + 6R_2O_3 + 5RO + 4HO$.
Margarodite, Three-Rock Mountain (Haughton), ...	$3SiO_3 + 2R_2O_3 + RO + 2HO$.
Margarodite, St. Etienne (Delesse),	$3SiO_3 + 2R_2O_3 + RO + 1{\cdot}3HO$.
Margarodite, Connecticut (Brush and Smith), ...	$3SiO_3 + 2R_2O_3 + RO + 1{\cdot}6HO$.
Damourite, Brittany (Delesse), .	$4SiO_3 + 3R_2O_3 + RO + 2HO$.
Mineral from Connemara (Apjohn),	$4SiO_3 + 3R_2O_3 + RO + 2HO$.

The preceding Table may be also thus written:—

TABLE III.

Talcite (Tennant), ...	$(\frac{1}{5}3RO + \frac{4}{5}R_2O_3)\,\frac{6}{5}SiO_3 + 4HO$.
Talcite (Short), ...	$(\frac{2}{11}3RO + \frac{9}{11}R_2O_3)\,\frac{15}{11}SiO_3 + HO$.
Gilbertite (Lehunt), ...	$(\frac{2}{17}3RO + \frac{15}{17}R_2O_3)\,\frac{18}{17}SiO_3 + 3HO$.
Gilbertite (Thomson), . . .	$(\frac{5}{23}3RO + \frac{18}{23}R_2O_3)\,\frac{30}{23}SiO_3 + 4HO$.
Margarodite (Haughton), . . .	$(\frac{1}{7}3RO + \frac{6}{7}R_2O_3)\,\frac{9}{7}SiO_3 + 1{\cdot}3HO$.
Margarodite (Delesse), . . .	Do. do.
Margarodite (Smith and Brush), .	Do. do.
Cleggan Mineral (Apjohn), . .	$(\frac{1}{10}3RO + \frac{9}{10}R_2O_3)\,\frac{6}{5}SiO_3 + 2HO$.
Damourite (Delesse), ...	Do. do.

Of these different minerals, the only one which has exactly the same composition with mine is the Damourite of Delesse. The analysis is given in Dufresnoy's Mineralogy; and upon examining it, I find it yields precisely the same formula as that at which I have arrived for the mineral from Cleggan. I may add that it has the same specific gravity (2·792), the same degree of hardness, the same colour and lustre, and behaves before the blow-pipe in a similar manner. In fact, I cannot entertain any doubt that they are both specimens of the same species.

The Wicklow Talcites, analysed by Short and Tennant, are quite distinct from my mineral, their formulæ being different, and the fixed alkalies being absent from them. The same may be said of the Cornish Gilbertites; only one of these (that analysed by Thomson) includes an alkali, and this is altogether soda. The Margarodites of Haughton, Delesse, and Brush, appear to be identical minerals; but, although including the alkalies in considerable quantity, their formulæ are so dif-

ferent from that of the Cleggan mineral, and from Damourite, that the two latter cannot be confounded with them. Their physical characters also are, I believe, materially different from Damourite. This is certainly true of the mineral analysed by our Chairman,—a specimen of the speckled mica of the Three-Rock Mountain,—but which Greg and Lettsom have most unjustifiably denominated *Talcite*.

And here it will be proper to observe, that our able and indefatigable President, in his valuable Notes on Irish Mines, has given the analysis of a pale-green steatitic substance, which he describes as often occurring in the mineral lodes of Wicklow, and the granite which they traverse. This mineral might certainly be called a Talcite, from its resemblance to some varieties of Talc. It is also similar in appearance to Damourite; but differs from it somewhat in composition,—not, however, to such a degree as to render it impossible that they should be the same mineral. The close analogy between the two minerals will be best seen by writing the formula of each upon the hypothesis which assumes that a protoxide and a sesquioxide can replace each other in quantities which include the same amount of oxygen. Written on this plan, the pale-green steatitic mineral of Professor Haughton, and the mineral from Connemara, will be represented as follows:—

Mineral from Connemara, . . $(\frac{1}{10}3RO + \frac{9}{10}R_2O_3)\,\frac{6}{5}SiO_3$.
Pale-green steatitic mineral, . $(\frac{1}{10}3RO + \frac{9}{10}R_2O_3)\,\frac{3}{2}SiO_3$.

The discrepancy between these formulæ is certainly small, and I incline to the opinion that the minerals to which they refer will ultimately prove to be the same; or, in other words, that Professor Haughton has preceded me in detecting the Damourite in Ireland. The locality of Cleggan, in Connemara, will still be distinguished by containing this mineral in large masses, spread over an extensive district, and not merely as a thin, superficial coating on granitic rocks, the form in which it has been found in Wicklow.

The Damourite of Delesse was, as has been already mentioned, found associated with numerous crystals of Kyanite. I have now to state that the Damourite of Connemara has imbedded in it numerous prismatic nodules, more or less rounded, of a mineral having the same composition as Kyanite, and well known under the name of Andalusite. In thin splinters, it has something of a flesh-red colour; is subtranslucent, and infusible before the blow-pipe. The crystalline form could seldom be deduced from an examination of the nodules; but in one or two specimens the outline of the right rhombic prism could be traced without difficulty. The specific gravity, taken with great care, was 2·9952, a number which may be considered as identical with 3, the latter being that usually given in systematic works as representing the density of Andalusite. This coincidence in physical characters is so complete, that it seemed almost superfluous to submit the imbedded nodules to analysis. For fear, however, of any mistake, this precaution was taken; and it was found that the experimental results corresponded sufficiently well with the formula

$3Al_2O_3$, $2SiO_3$, which is known to represent the composition of most varieties of Andalusite. Nothing more, I may observe, than an approximation to the truth could be expected; for the nodules were so coated on the surface, and penetrated throughout with flakes of the Damourite, that it was found impossible to obtain for experimental purposes specimens of perfect purity.

XV.—Letter from Mr. Thomas Stanley on the Faults sometimes found in the Drift Gravel of Ireland.

[Read before the Geological Society of Dublin, June 18, 1860.]

Tullamore, June 8, 1860.

Sir,—I beg to inform you that I had been occasionally upon the line of rail which runs from this town to Athlone during the time of its construction; and, while I amused myself with the gossip of holiday folks, who used to be loitering about, and all agape at the gashes in the green-hill sides, and other objects of wonder, I was not inattentive to the geological features which were presented; and drift phenomena—an old hobby of mine—could not possibly be forgotten. All the cuttings of the way were in drift deposits. Four great esker ridges were opened; one of these, which runs beside Clara, when in section, exhibited sands and gravels stratified in a very beautiful manner. While I was testing the stratification of this esker, I was greatly surprised to find the whole mass broken through with faults. The strata from the surface to the lowest sinkings were cut by perpendicular fractures; some of which were close by each other, and some were a few yards apart; and the elevations and depressions varied from two or three inches to as many feet. The direction of the break was parallel to the range of the hill. Being aware that there was another sinking in a similar pile near the Terminus in Athlone, I took the earliest opportunity to see it. I found the disturbance greater here than at Clara, the breaks being closer to each other, and more complicated. And here, while resting amongst these sands, at the end of a toilsome journey, the reward and chief object of which were lying open like a great book before me, I was not a little amused with the geology of three of Athlone's burghers. Peacock, calling to Peacock, —while I escaped being run over by them,—Why is it that these sands are always found without stones? And Peacock responding, Why, Peacock, it is because no stones are ever found in them. The disturbance evidently increases with the distance from Tullamore. There are not many breaks in strata in the neighbourhood of this town. This is probably part of an extensive disturbance which is known to have occurred in the drift. In some papers, which were addressed to your Society, I noticed the almost demonstrable fact of an ebb interval of some centuries occurring between two drifts, or overflow periods; and it is probable that our disturbance took place in this interval. Though the faults are

continued upwards to the surface, they do not break the smooth outline of hill; and patches which have not known cultivation should retain a ridge and furrow, if there had not been a levelling agent. It is certain that overflows succeeded the disturbance, which removed the inequalities I noticed in clay deposits overlying the faults in some instances.

I am your obedient servant,

THOMAS STANLEY.

Professor Haughton, Trinity College, Dublin.

XVI.—ON THE GENERAL THEORY OF THE INTEGRATION OF NON-LINEAR PARTIAL DIFFERENTIAL EQUATIONS. By the REV. ROBERT CARMICHAEL, F. T. C. D.

[Read before the Royal Irish Academy, Monday, February 11, 1861.]

A COMPLETE theory of the genesis and solution of non-linear partial differential equations of the second and higher orders, in two or more independent variables, has been long a desideratum; and any considerable addition to our knowledge in this department of science can only be expected from the combined labours of those who have devoted some attention to this branch of the Integral Calculus. The following paper is intended as a small contribution towards the formation of such a theory. The solutions of non-linear partial differential equations are sought in the form of what are denominated 'complete primitives,' exhibiting arbitary constants, as contradistinguished from 'general primitives,' exhibiting arbitrary functions. It is allowed that solutions in the latter form are more general; but then they are theoretically unattainable, unless in certain cases which, the equations being linear, admit of symbolic treatment, or which are susceptible of reduction by methods not universally applicable. The importance of the subject, partly in connexion with the Calculus of Variations, and partly with the higher branches of mathematical physics, cannot well be overrated. It is well known that in the more advanced departments of mathematical physics one of the principal obstacles to our progress arises from the difficulty of integrating the partial differential equations which represent the conditions of the problem investigated; that these integrals have been sought in form of general primitives, which are in most cases unattainable; and that, if such forms of solution are attainable, a fresh difficulty arises upon our seeking to determine the forms of the arbitrary functions introduced. It is impossible now to determine what may be the physical value of the integrals of such differential equations, when stated in the form of complete primitives; but, in the default of better, such solutions may afford us, at least, *some* information. The following remarks are offered in the hope of being thus beneficial:—

1. If we are given any equation, including two arbitrary constants α, β, and two independent variables x, y,

$$f(x, y, z, \alpha, \beta) = 0, \qquad \text{(I)}$$

we may differentiate this equation with respect to the independent variables x and y, thus obtaining

$$\left(\frac{df}{dx}\right) = 0, \left(\frac{df}{dy}\right) = 0;$$

and, by eliminating α, β between the three equations stated, we get a partial differential equation, in general non-linear,

$$F\left(x, y, z, \frac{dz}{dx}, \frac{dz}{dy}\right) = F(x, y, z, p, q) = 0,$$

of which (I) is said to be a *complete primitive.*

2. Again if, u being any function of known form in x, y, z, we were given an equation of the type

$$f_{\prime}\{x, y, z, \phi(u)\} = 0, \qquad \text{(I}'\text{)}$$

ϕ being any arbitrary function, we might differentiate as before, and eliminate ϕ, ϕ', thus again arriving at a partial differential equation

$$F_{\prime}\left(x, y, z, \frac{dz}{dx}, \frac{dz}{dy}\right) = F_{\prime}(x, y, z, p, q) = 0,$$

of which (I′) is said to be the *general primitive.*

3. Similarly, if we are given any equation including three arbitrary constants α, β, γ, and three independent variables x, y, z,

$$f(x, y, z, w, \alpha, \beta, \gamma) = 0, \qquad \text{(II)}$$

we may differentiate this equation with respect to the independent variables x, y, z, thus obtaining

$$\left(\frac{df}{dx}\right) = 0, \left(\frac{df}{dy}\right) = 0, \left(\frac{df}{dz}\right) = 0;$$

and, by eliminating α, β, γ between the four equations stated, we would get a partial differential equation in three independent variables, in general non-linear,

$$F\left(x, y, z, w, \frac{dw}{dx}, \frac{dw}{dy}, \frac{dw}{dz}\right) = 0,$$

of which (II) would be said to be a complete primitive.

If, instead of differentiating with respect to the independent variables, we had differentiated with respect to the arbitrary constants, thus getting

$$\frac{df}{d\alpha} = 0, \frac{df}{d\beta} = 0, \frac{df}{d\gamma} = 0,$$

and then eliminated the arbitrary constants between the given equation and these three, we would obtain a result of the form

$$F(x, y, z, w) = 0,$$

which will, in general, satisfy the partial differential equation, previously derived,

$$F\left(x, y, z, w, \frac{dw}{dx}, \frac{dw}{dy}, \frac{dw}{dz}\right) = 0,$$

and, as it exhibits no arbitrary constants, may be denominated its singular solution.

4. Again if, u and v being any functions of known form in x, y, z, w, we were given an equation of the type

$$f_{\prime\prime}\{x, y, z, w, \phi(u, v)\} = 0, \qquad \text{(II}'\text{)}$$

ϕ being any arbitrary function, we may differentiate with respect to the independent variables x, y, z, and eliminate

$$\phi, \frac{d\phi}{du}, \frac{d\phi}{dv},$$

thus again obtaining a partial differential equation

$$F_{\prime\prime}\left(x, y, z, w, \frac{dw}{dx}, \frac{dw}{dy}, \frac{dw}{dz}\right) = 0,$$

of which (II′) may be said to be the general primitive.

5. Proceeding by analogy, being given any equation in two independent variables, but exhibiting *five* arbitrary constants,

$$f(x, y, z, \alpha, \beta, \gamma, \delta, \epsilon) = 0, \qquad \text{(III)}$$

we may differentiate this equation twice successively with respect to x and y, and eliminate the arbitrary constants between the given equation and

$$\left(\frac{df}{dx}\right) = 0, \left(\frac{df}{dy}\right) = 0, \left(\frac{d^2f}{dx^2}\right) = 0, \left(\frac{d^2f}{dxdy}\right) = 0, \left(\frac{d^2f}{dy^2}\right) = 0.$$

Thus we should obtain a partial differential equation of the second order, in general non-linear, of the form (adopting the ordinary notation),

$$F(x, y, z, p, q, r, s, t) = 0, \qquad \text{(IV)}$$

of which (III) may be said to be a complete primitive.

6. It does not follow, however, (as is known), that, in general, from a given finite equation exhibiting *two arbitrary functions*, we can pass to a partial differential equation of the second order. For if, u and v being any two functions of known form in x, y, z, we were given any equation of the type

$$f(x, y, z, \phi u, \psi v) = 0,$$

differentiating this equation twice successively with respect to x and y

we only get six equations, which, ordinarily, are *not* sufficient to enable us to eliminate *the six* quantities

$$\phi, \phi', \phi'', \psi, \psi', \psi''.$$

It is true indeed that, in the case of *linear* partial differential equations of the second order, *which admit of treatment by symbolic methods*, we do, in most cases, obtain the solutions, in the form of general primitives, by direct procedures, and exhibiting two arbitrary functions. But the fact, which has just been alluded to, would appear to show that in the case of *non-linear* partial differential equations of the second and higher orders, which do not admit in general of treatment by symbolic methods, the species of solution which we should seek to obtain, should be, not the general primitive exhibiting arbitrary functions, but the complete primitive exhibiting arbitrary constants; and the mode of integration which we should seek to perfect, should be that by which the complete primitives of such partial differential equations are sought, and not their general primitives.

7. Moreover, we may differentiate the equation

$$f(x, y, z, \alpha, \beta, \gamma, \delta, \epsilon) = 0$$

with respect to the arbitrary constants, and between the five equations thus found, namely,

$$\frac{df}{d\alpha} = 0, \frac{df}{d\beta} = 0, \frac{df}{d\gamma} = 0, \frac{df}{d\delta} = 0, \frac{df}{d\epsilon} = 0,$$

and the given equation, eliminate α, β, γ, δ, ϵ, thus obtaining a resulting equation of the form

$$F_{\prime}(x, y, z) = 0. \tag{V}$$

It may be interesting to inquire what relation this equation bears to the corresponding partial differential equation (IV); in other words, whether there is any such relation between the two, as would justify us in denominating (V), *in any case*, the singular solution of (IV): what analytical conditions would be requisite in order that the former equation should satisfy the latter: and what may be the geometrical significance of singular solutions of partial differential equations of the second order, if such singular solutions are admissible or conceivable.

As regards the analytical conditions specified, they may be investigated thus. Differentiating the equation

$$f(x, y, z, \alpha, \beta, \gamma, \delta, \epsilon) = 0$$

with respect to all the variables, we get identically

$$\left(\frac{df}{dx}\right) dx + \left(\frac{df}{dy}\right) dy + \frac{df}{d\alpha} d\alpha + \frac{df}{d\beta} d\beta + \frac{df}{d\gamma} d\gamma + \frac{df}{d\delta} d\delta + \frac{df}{d\epsilon} d\epsilon = 0,$$

which, in consequence of the relations supposed, reduces to

$$\left(\frac{df}{dx}\right) dx + \left(\frac{df}{dy}\right) dy = 0,$$

or, as dx and dy are independent, we have the first two of the relations stated in the fifth article, namely,

$$\left(\frac{df}{dx}\right) = 0, \left(\frac{df}{dy}\right) = 0.$$

So far all is plain; but when we proceed to differentiate these equations again with respect to all the variables, we get

$$\left(\frac{d^2f}{dx^2}\right) dx + \left(\frac{d^2f}{dxdy}\right) dy + \left(d\alpha \frac{d}{d\alpha} + d\beta \frac{d}{d\beta} + d\gamma \frac{d}{d\gamma} + d\delta \frac{d}{d\delta} + d\epsilon \frac{d}{d\epsilon}\right)\left(\frac{df}{dx}\right) = 0$$

$$\left(\frac{d^2f}{dy^2}\right) dy + \left(\frac{d^2f}{dxdy}\right) dx + \left(d\alpha \frac{d}{d\alpha} + d\beta \frac{d}{d\beta} + d\gamma \frac{d}{d\gamma} + d\delta \frac{d}{d\delta} + d\epsilon \frac{d}{d\epsilon}\right)\left(\frac{df}{dy}\right) = 0,$$

which are not equivalent to the remaining relations of the fifth article, namely,

$$\left(\frac{d^2f}{dx^2}\right) = 0, \left(\frac{d^2f}{dxdy}\right) = 0, \left(\frac{d^2f}{dy^2}\right) = 0,$$

unless, simultaneously,

$$\left.\begin{aligned}\left(d\alpha \frac{d}{d\alpha} + d\beta \frac{d}{d\beta} + d\gamma \frac{d}{d\gamma} + d\delta \frac{d}{d\delta} + d\epsilon \frac{d}{d\epsilon}\right) . \left(\frac{df}{dx}\right) = 0 \\ \left(d\alpha \frac{d}{d\alpha} + d\beta \frac{d}{d\beta} + d\gamma \frac{d}{d\gamma} + d\delta \frac{d}{d\delta} + d\epsilon \frac{d}{d\epsilon}\right) . \left(\frac{df}{dy}\right) = 0\end{aligned}\right\}$$

8. It is known that, if we are given any system of surfaces exponible by the partial differential equation of the first order

$$F(x, y, z, p, q) = 0,$$

we can, in general, determine the character of this system by finding the integral of the differential equation, either in the form of a complete primitive, or a general primitive.

Again, if we are given any system of surfaces exponible by the partial differential equation of the second order

$$F(x, y, z, p, q, r, s, t) = 0,$$

we may, in general, determine the character of this system by finding, if we can, the integral of the differential equation, either in the form of a complete primitive, or a general primitive.

If the solution, in either of these two cases, be obtained in the form of a general primitive, the form of the arbitrary function or functions

introduced is, in general, determined by supposing the surface to pass through a given curve or curves. The difficulty of applying this principle, in practice, is well known.

If, on the other hand, the solution, in either case, be obtained in the form of a complete primitive, everything required by the solution is determined if, in the former case, *two points* upon the surface represented by the partial differential equation be given, and, in the latter case, *five points*. More generally, if the given non-linear partial differential equation be of the first order and include n independent variables, it is sufficient, for the determination of the function represented, in the form of a complete primitive, that we be given n systems of correspondent values of the variables. If the given non-linear partial differential equation be of the second order, and include n independent variables, it is sufficient for the complete determination of the function represented, that we be given $\frac{n(n+3)}{2}$ systems of correspondent values of the variables.

9. I now proceed to discuss certain examples with the view of showing the *feasibility* of obtaining solutions, in the form of complete primitives, of non-linear partial differential equations of the second order, and, in the following article, a general method for deriving such solutions will be indicated: the completion of the subject is reserved for a supplementary communication.

Examples.

(1). Let it be proposed to determine the solution, in the form of a complete primitive, of the non-linear partial differential equation

$$\frac{1}{p} + \frac{1}{q} = 1. \qquad (1)$$

The auxiliary system, adopting the method of Lagrange and Charpit, gives

$$dp = 0,$$

since

$$\frac{dq}{dx} = 0, \frac{dq}{dz} = 0.$$

Hence, c being any arbitrary constant,

$$p = c \quad , \quad \text{and} \quad q = \frac{c}{c-1};$$

and substituting these values in the general equation

$$dz = pdx + qdy$$

we get, writing $\frac{1}{a}$ for c,

$$z = \frac{x}{a} + \frac{y}{1-a} + \beta. \qquad (2)$$

This then is *a* complete primitive of the given equation, and it is at once seen to satisfy it. But, moreover, if we examine the other equations of the auxiliary system in this case, namely,

$$(p-1)^2\, dx = dy = \left(\frac{p-1}{p}\right)^2 dz,$$

we see that no other complete primitive is deducible. In other words, equation (2) is *the* complete primitive of (1).

If β be made an arbitrary function of a, we get as the general primary of (1)

$$\left.\begin{aligned} z &= \frac{x}{a} + \frac{y}{1-a} + \phi(a) \\ 0 &= \frac{x}{a^2} - \frac{y}{(1-a)^2} - \phi'(a) \end{aligned}\right\}.$$

(2). If it be now proposed to integrate the higher differential equation in three independent variables (and a corresponding method will apply generally)

$$\frac{1}{\frac{dw}{dx}} + \frac{1}{\frac{dw}{dy}} + \frac{1}{\frac{dw}{dz}} = 1,$$

let us assume for w the linear form

$$w = \frac{x}{a} + \frac{y}{\beta} + \frac{z}{\gamma} + \kappa,$$

where a, β, γ, κ are arbitrary constants. Then, by substitution, we find that this will be the solution required, if the arbitrary constants be connected by the relation

$$a + \beta + \gamma = 1.$$

Hence the complete primitive of the given equation is, writing γ for κ,

$$w = \frac{x}{a} + \frac{y}{\beta} + \frac{z}{1-(a+\beta)} + \gamma,$$

and the general primary

$$\left.\begin{aligned} w &= \frac{x}{a} + \frac{y}{\beta} + \frac{z}{1-(a+\beta)} + \phi(a,\beta) \\ 0 &= \frac{d}{da}\left\{\frac{x}{a} + \frac{y}{\beta} + \frac{z}{1-(a+\beta)} + \phi(a,\beta)\right\} \\ 0 &= \frac{d}{d\beta}\left\{\frac{x}{a} + \frac{y}{\beta} + \frac{z}{1-(a+\beta)} + \phi(a,\beta)\right\} \end{aligned}\right\}.$$

I have ventured to denominate the system of equations just written, the 'general primary' solution of the given partial differential equation, instead of, as it is usually denominated, the 'general primitive.' It would seem to be right to distinguish between the two cases, where one arbitrary constant is made an arbitrary function of one or more others, and where an arbitrary function of the variables is introduced. It is true, indeed, that in some cases these duplicate solutions coincide, as, for instance, in the case of the general functional equation of surfaces of revolution, namely,

$$lx + my + nz = \phi(x^2 + y^2 + z^2)$$

which may be readily identified with the general primary, obtained from the complete primitive

$$(x - c\cos\lambda)^2 + (y - c\cos\mu)^2 + (z - c\cos\nu)^2 = \gamma^2,$$

by putting $c = \psi(r)$; but such identification does not appear to be generally possible.

It is easy to see how the following non-linear partial differential equations are but modifications of the simple examples treated, namely,

$$\left.\begin{aligned} \frac{1}{p} + \frac{1}{q} &= \frac{k}{z} \\ \frac{x}{p} + \frac{y}{q} &= kz \\ \frac{x^m}{p} + \frac{y^m}{q} &= kz^m \end{aligned}\right\}; \text{ or } \left\{\begin{aligned} &\frac{1}{\frac{dw}{dx}} + \frac{1}{\frac{dw}{dy}} + \frac{1}{\frac{dw}{dz}} = \frac{k}{w} \\ &\frac{x}{\frac{dw}{ax}} + \frac{y}{\frac{dw}{dy}} + \frac{z}{\frac{dw}{dz}} = kw, \\ &\frac{x^m}{\frac{dw}{dx}} + \frac{y^m}{\frac{dw}{dy}} + \frac{z^m}{\frac{dw}{dz}} = kw^m, \end{aligned}\right.$$

the solutions being, respectively,

$$\left.\begin{aligned} \log z &= \frac{1}{k}\left(\frac{x}{a} + \frac{y}{1-a} + \beta\right) \\ z^2 &= \frac{1}{k}\left(\frac{x^2}{a} + \frac{y^2}{1-a} + \beta\right) \\ z^{m+1} &= \frac{1}{k}\left(\frac{x^{m+1}}{a} + \frac{y^{m+1}}{1-a} + \beta\right) \end{aligned}\right\}$$

and

$$\left.\begin{aligned}\log w &= \frac{1}{k}\left(\frac{x}{\alpha} + \frac{y}{\beta} + \frac{z}{1-(\alpha+\beta)} + \gamma\right)\\ w^2 &= \frac{1}{k}\left(\frac{x^2}{\alpha} + \frac{y^2}{\beta} + \frac{z^2}{1-(\alpha+\beta)} + \gamma\right)\\ w^{m+1} &= \frac{1}{k}\left(\frac{x^{m+1}}{\alpha} + \frac{y^{m+1}}{\beta} + \frac{z^{m+1}}{1-(\alpha+\beta)} + \gamma\right)\end{aligned}\right\}.$$

(3). If it were proposed to integrate the non-linear partial differential equation of the second order, in two independent variables,

$$\frac{1}{r} + \frac{1}{t} = \frac{1}{\frac{d^2z}{dx^2}} + \frac{1}{\frac{d^2z}{dy^2}} = 1,$$

we would assume, by analogy, the solution to be

$$z = \frac{x^2}{2\alpha} + \frac{y^2}{2(1-\alpha)} + \frac{xy}{\beta} + \frac{x}{\gamma} + \frac{y}{\delta} + \epsilon;$$

and it is instantly evident that this is a complete primitive of the given equation, since it satisfies it, and exhibits five arbitrary constants.

Similarly, the solution, in the form of a complete primitive, of the non-linear partial differential equation of the second order, in three independent variables,

$$\frac{1}{\frac{d^2w}{dx^2}} + \frac{1}{\frac{d^2w}{dy^2}} + \frac{1}{\frac{d^2w}{dz^2}} = 1,$$

is

$$w = \frac{x^2}{2\alpha} + \frac{y^2}{2\beta} + \frac{z^2}{2(1-\alpha+\beta)} + \frac{yz}{\gamma} + \frac{zx}{\delta} + \frac{xy}{\epsilon} + \frac{x}{\zeta} + \frac{y}{\eta} + \frac{z}{\theta} + \kappa,$$

since, as before, it satisfies the given partial differential equation, and exhibits nine arbitrary constants.

It is readily seen that if the former of the two partial differential equations now treated, had been

$$\frac{1}{r} + \frac{1}{s} + \frac{1}{t} = \frac{1}{\frac{d^2z}{dx^2}} + \frac{1}{\frac{d^2z}{dxdy}} + \frac{1}{\frac{d^2z}{dy^2}} = 1,$$

we should have, for a complete primitive, the obvious modification

$$z = \frac{x^2}{2\alpha} + \frac{y^2}{2\beta} + \frac{xy}{1-(\alpha+\beta)} + \frac{x}{\gamma} + \frac{y}{\delta} + \epsilon.$$

(4). It follows readily from the forms of solution arrived at in the examples just discussed, that the complete primitive of any non-linear partial differential equation of the type

$$f(p, q) = 0,$$

is the linear expression

$$z = ax + by + c,$$

where a and b are connected by the equation

$$f(a, b) = 0.$$

Thus the complete primitive of the partial differential equation

$$\frac{1}{p^m} + \frac{1}{q^m} = k$$

is

$$z = \frac{x}{a^{\frac{1}{m}}} + \frac{y}{(1-a)^{\frac{1}{m}}} + \beta.$$

More generally, the complete primitive of the partial differential equation in three independent variables

$$\frac{1}{\left(\frac{dw}{dx}\right)^m} + \frac{1}{\left(\frac{dw}{dy}\right)^m} + \frac{1}{\left(\frac{dw}{dz}\right)^m} = 1$$

is

$$w = \frac{x}{a^{\frac{1}{m}}} + \frac{y}{\beta^{\frac{1}{m}}} + \frac{z}{(1-a+\beta)^{\frac{1}{m}}} + \gamma.$$

Similarly, the integral of the partial differential equation

$$\frac{1}{r^m} + \frac{1}{t^m} = \frac{1}{\left(\frac{d^2z}{dx^2}\right)^m} + \frac{1}{\left(\frac{d^2z}{dy^2}\right)^m} = 1,$$

in the form of a complete primitive, is

$$z = \frac{x^2}{2a^{\frac{1}{m}}} + \frac{y^2}{2(1-a)^{\frac{1}{m}}} + \frac{xy}{\beta} + \frac{x}{\gamma} + \frac{y}{\delta} + \epsilon;$$

and the solution of

$$\frac{1}{\left(\frac{d^2w}{dx^2}\right)^m} + \frac{1}{\left(\frac{d^2w}{dy^2}\right)^m} + \frac{1}{\left(\frac{d^2w}{dz^2}\right)^m} = 1$$

is

$$w = \frac{x^2}{2\alpha^{\frac{1}{m}}} + \frac{y^2}{2\beta^{\frac{1}{m}}} + \frac{z^2}{2(1-\overline{\alpha+\beta})^{\frac{1}{m}}} + \frac{yz}{\gamma} + \frac{zx}{\delta} + \frac{xy}{\epsilon} + \frac{x}{\zeta} + \frac{y}{\eta} + \frac{z}{\theta} + \kappa.$$

So, again, the complete primitive of the partial differential equation

$$\frac{1}{r^m} + \frac{1}{s^m} + \frac{1}{t^m} = 1,$$

is

$$z = \frac{x^2}{2\alpha^{\frac{1}{m}}} + \frac{y^2}{2\beta^{\frac{1}{m}}} + \frac{xy}{(1-\overline{\alpha+\beta})^{\frac{1}{m}}} + \frac{x}{\gamma} + \frac{y}{\delta} + \epsilon.$$

(5.) It may be interesting to compare for a particular case the solution in the form of a complete primitive with the solution in the form of a general primitive. Thus let us take the equation

$$r + 2s + t = \frac{d^2z}{dx^2} + 2\,\frac{d^2z}{dxdy} + \frac{d^2z}{dy^2} = 1.$$

The solution of this equation by the symbolic method, in the form of a general primitive, is readily found to be

$$z = \frac{xy}{2} + \frac{x+y}{2}.\ \phi\,(x-y) + \psi\,(x-y).$$

The solution of the same equation, in the form of a complete primitive, is

$$z = \tfrac{1}{2}\,\{\alpha x^2 + \beta y^2 + (1-\overline{\alpha+\beta})\,xy\} + \gamma x + \delta y + \epsilon.$$

These solutions may be readily identified by assuming

$$\begin{aligned}\phi(x-y) &= \mathrm{A}(x-y) + \mathrm{A}',\\ \psi(x-y) &= \mathrm{B}(x-y)^2 + \mathrm{B}'\,(x-y) + \mathrm{B}'',\end{aligned}$$

whence, by substitution in the former, we get

$$z = \frac{xy}{2} + \tfrac{1}{2}\,\{\mathrm{A}\,(x^2-y^2) + \mathrm{A}'(x+y)\} + \{\mathrm{B}\,(x-y)^2 + \mathrm{B}'(x-y) + \mathrm{B}''\}$$

and, by comparison of co-efficients,

$$\begin{aligned}&\tfrac{1}{2}\mathrm{A} + \mathrm{B} = \tfrac{1}{2}\alpha,\ \mathrm{B} - \tfrac{1}{2}\mathrm{A} = \tfrac{1}{2}\,\beta,\ 2\mathrm{B} = \tfrac{1}{2}(\alpha+\beta),\\ &\tfrac{1}{2}\mathrm{A}' + \mathrm{B}' = \gamma,\ \tfrac{1}{2}\mathrm{A}' - \mathrm{B}' = \delta, \quad \mathrm{B}'' = \epsilon.\end{aligned}$$

A similar identification may be performed upon the solutions, in the two forms, of the equation

$$r + t = 1.$$

Thus it appears that the general primitive may be reduced to the complete primitive, but not *vice versâ*.

(6.) The following will serve as examples of the latter portion of the third article. Let the partial differential equation proposed for solution be

$$x\frac{dw}{dx}+y\frac{dw}{dy}+z\frac{dw}{dz}=\left\{a^m\left(\frac{dw}{dx}\right)^m+b^m\left(\frac{dw}{dy}\right)^m+c^m\left(\frac{dw}{dz}\right)^m\right\}^{\frac{1}{m}},$$

where a, b, c are given constants: then the solution of this equation, in the form of a complete primitive, is

$$w=\alpha x+\beta y+\gamma z-\{a^m\alpha^m+b^m\beta^m+c^m\gamma^m\}^{\frac{1}{m}}=0,$$

and the singular solution is

$$\left(\frac{x}{a}\right)^{\frac{m}{m-1}}+\left(\frac{y}{b}\right)^{\frac{m}{m-1}}+\left(\frac{z}{c}\right)^{\frac{m}{m-1}}=1.$$

Thus, if $m=3$, the singular solution of the partial differential equation

$$x\frac{dw}{dx}+y\frac{dw}{dy}+z\frac{dw}{dz}=\left\{a^3\left(\frac{dw}{dx}\right)^3+b^3\left(\frac{dw}{dy}\right)^3+c^3\left(\frac{dw}{dz}\right)^3\right\}^{\frac{1}{3}}$$

is

$$\left(\frac{x}{a}\right)^{\frac{3}{2}}+\left(\frac{y}{b}\right)^{\frac{3}{2}}+\left(\frac{z}{c}\right)^{\frac{3}{2}}=1.$$

Again, if $m=\frac{1}{2}$, the singular solution of

$$x\frac{dw}{dx}+y\frac{dw}{dy}+z\frac{dw}{dz}=\left\{\left(a\frac{dw}{dx}\right)^{\frac{1}{2}}+\left(b\frac{dw}{dy}\right)^{\frac{1}{2}}+\left(c\frac{dw}{dz}\right)^{\frac{1}{2}}\right\}^2$$

is

$$\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=1.$$

Finally, it is easily proved that the singular solution of the partial differential equation

$$a\frac{dw}{dx}\left\{x\frac{dw}{dx}+y\frac{dw}{dy}+z\frac{dw}{dz}\right\}+b^2\left(\frac{dw}{dy}\right)^2+c^2\left(\frac{dw}{dz}\right)^2=0$$

is the paraboloid

$$\frac{y^2}{b^2}+\frac{z^2}{c^2}=\frac{4x}{a}.$$

Generalisation of Charpit's Method.

10. Let us suppose that the given non-linear partial differential equation is reduced to the form

$$s = f(x, y, z, p, q, r, t).$$

Then we have the two conditions

$$\left(\frac{dr}{dy}\right) = \left(\frac{ds}{dx}\right), \quad \left(\frac{dt}{dx}\right) = \left(\frac{ds}{dy}\right).$$

Now on supposition that r is expressed generally as a function of x, y, z, p, and q, we have

$$\left(\frac{dr}{dy}\right) = \frac{dr}{dy} + \frac{dr}{dz} q + \frac{dr}{dp} s + \frac{dr}{dq} t,$$

and

$$\left(\frac{ds}{dx}\right) = \frac{ds}{dx} + \frac{ds}{dz} p + \frac{ds}{dp} r + \frac{ds}{dq} s + \frac{ds}{dr}\left(\frac{dr}{dx} + \frac{dr}{dz} p + \frac{dr}{dp} r + \frac{dr}{dq} s\right) + \frac{ds}{dt}\left(\frac{dt}{dx} + \frac{dt}{dz} p + \frac{dt}{dp} r + \frac{dt}{dq} s\right).$$

Hence, equating and arranging terms, we get a linear partial differential equation in r and t as dependent variables, and x, y, z, p, q as independent variables, namely,

$$\left.\begin{aligned} &-\frac{ds}{dr}\cdot\frac{dr}{dx} + \frac{dr}{dy} + \left(q - p\frac{ds}{dr}\right)\frac{dr}{dz} + \left(s - r\frac{ds}{dr}\right)\frac{dr}{dp} + \left(t - s\frac{ds}{dr}\right)\frac{dr}{dq} \\ &-\frac{ds}{dt}\left(\frac{dt}{dx} + p\frac{dt}{dz} + r\frac{dt}{dp} + s\frac{dt}{dq}\right) = \frac{ds}{dx} + \frac{ds}{dz} p + \frac{ds}{dp} r + \frac{ds}{dq} s \end{aligned}\right\} (\alpha)$$

in which, of course, the co-efficients $\frac{ds}{dx}, \frac{ds}{dy}, \frac{ds}{dz}, \frac{ds}{dp}$, &c., are all known functions of x, y, z, p, q, r, and t.

The second condition gives the corresponding equation

$$\left.\begin{aligned} &\frac{dt}{dx} - \frac{ds}{dt}\cdot\frac{dt}{dy} + \left(p - q\frac{ds}{dt}\right)\frac{dt}{dz} + \left(r - s\frac{ds}{dt}\right)\frac{dt}{dp} + \left(s - t\frac{ds}{dt}\right)\frac{dt}{dq} \\ &-\frac{ds}{dr}\left(\frac{dr}{dy} + q\frac{dr}{dz} + s\frac{dr}{dp} + t\frac{dr}{dq}\right) = \frac{ds}{dy} + \frac{ds}{dz} q + \frac{ds}{dp} s + \frac{ds}{dq} t \end{aligned}\right\} (\beta)$$

in which, as before, the co-efficients $\frac{ds}{dy}, \frac{ds}{dz}$, &c., are known functions of x, y, z, p, q, r, and t.

This system of simultaneous partial differential equations may be much simplified by writing

$$\frac{d}{dx} + p\frac{d}{dz} + r\frac{d}{dp} + s\frac{d}{dq} = X,$$

$$\frac{d}{dy} + q\frac{d}{dz} + s\frac{d}{dp} + t\frac{d}{dq} = Y,$$

$$\frac{ds}{dx} + p\frac{ds}{dz} + r\frac{ds}{dp} + s\frac{ds}{dq} = f_1(x, y, z, p, q, r, t)$$

$$\frac{ds}{dy} + q\frac{ds}{dz} + s\frac{ds}{dp} + t\frac{ds}{dq} = f_2(x, y, z, p, q, r, t)$$

$$\frac{ds}{dr} = R, \frac{ds}{dt} = T.$$

By making these substitutions, the given system of simultaneous partial differential equations becomes, simply,

$$\left.\begin{array}{l} Y.r - RX.r - TX.t = f_1 \\ X.t - TY.t - RY.r = f_2 \end{array}\right\}$$

Hence, in general, we have a system of two simultaneous linear partial differential equations to determine r and t in terms of p, q, x, y, z. Supposing these found, it remains to substitute their values in

$$\left.\begin{array}{l} dp = rdx + sdy \\ dq = sdx + tdy \end{array}\right\}$$

and integrate again. The values of p and q thus found are to be substituted, finally, in the equation

$$dz = pdx + qdy,$$

and by a third integration the solution required is, in general, determined. It will be evident that in the processes of successive integration indicated, five arbitrary constants are introduced.

XVII.—On the Comparative Value of the different Feeding Substances for Horses. By John Dowling, Student in the Evening Practical Chemical Class, Museum of Irish Industry.

[Read before the Royal Dublin Society, Monday, June 18, 1860.]

These experiments and accompanying analyses were undertaken with a double object in view:—1st, To ascertain the feeding values of different descriptions of horse foods; 2nd, To ascertain their chemical values, and, in connexion with their feeding values, to determine the conditions under which each and every sort of food is best adapted for use in producing work or making flesh. I regret that I have been unable to carry these experiments and analyses as far as I could have wished.

The analyses were conducted in the usual way. The moisture was determined by drying a weighed quantity of the substance at 212°, until it ceased to lose weight. For Indian-corn, bran, toppings, oats, and rape, I took 50 grs. of each; the oil, for which I took 50 grs., was dissolved out by ether, the ether subsequently distilled off, and the residual oil dried at 212°, till it ceased to lose weight; the ash, for which I took 50 grs. of substance, was estimated by igniting a weighed quantity until all organic matter was consumed; the albumen was determined by the quantity of nitrogen obtained by combustion of a weighed quantity of substance with soda-lime. In calculating, I have taken 15·92 as the quantity of nitrogen in 100 parts of vegetable albumen. The fibre was estimated by digesting 50 grs. for some days with dilute solution of potash, washing with acidified water, and finally with pure water, drying the residue at 212°, until it ceased to lose weight. The starch was estimated by difference.

When the oil is calculated as starch, I have from calculation found 10 of oil to equal 24 of starch. I have also determined, in the different samples of hay, the quantity of matter soluble in water; and have estimated in each case the ash and nitrogen, and in hay, L, the quantity of matter soluble in ether. To show what constituents are removed from the hay by the water, and their quantities, I have contrasted the composition of the hay, dried at 212° F., but not digested, with the composition of the digested hay, dried at 212° F. Two estimations were made of the substances in the digested portion, but I have only given the mean of the two. The different samples of hay I digested in water had previously been dried at 212° F. The substances which are removed from the hay by water, as the analyses show, are some of the mineral constituents—sugar and the colouring matter: the albuminous compounds were insoluble in water. When hay or grass is digested in ether, the ethereal solution has a beautiful green colour; but the colour of the ethereal solution from the digested hay is not green; indeed, it has very little, if any colour: the colouring matter is, therefore, destroyed, or altered in

character by the water. This part of the investigation explains the nature of the changes which hay suffers on exposure to rain.

The scientific part of the investigation was conducted in the laboratory of the Museum of Irish Industry, under the direction of Mr. Galloway.

From May 24 to July 4, the work-horses were fed on a mixture of crushed Indian corn, Irish oats, and bran from Black Sea wheat. The Indian corn cost 30*s.* per 480 lbs., the oats, 15*s.* 6*d*, per 196 lbs., and the bran, 4*s.* 6*d.* per 112 lbs. The analyses of these articles are given in a succeeding page; they are marked 1, 2, and 3. They also consumed in the above time 16 cwts. of first-crop hay, clover; and grasses, growth of 1858, costing 4*s.* 3*d.* per 112 lbs. The analysis of this hay is distinguished by the letter D.

The following tabular form gives the dates on which each weighing of food was given, the number of horses it kept, and the results as to quantity consumed and work performed :—

Dates.		No. of Horses and Time.	Grain Mixture.			Average per day consumed.	Days lasted.			Work performed.		
From	To		Indian Corn.	Oats.	Bran.		Total.	Worked.	Idle.	Total.	Per Worked Day.	Per Day for Whole Time.
			lbs.	lbs.	lbs.	lbs.				Tons.	Tons.	Tons.
May 24,	June 9,	3, whole time,	480	128	112	14·17	17	7	10	188½	9·0	3·27
June 10,	June 26,	ditto,	480	128	112	14·17	17	8	9	129	5·3	2·53
June 27,	July 4,	{ 2 for 8 days, 1 for 2 days, }	180	45	45	15·00	8	5	3	73½	6·1	4·08
Totals and Averages		{ 2 for 42 days, 1 for 36 days, }	1140	301	269	14·25	42	20	22	391	6·86	3·26

16 cwts. of hay for the above time and number of horses, that is, 2 horses for 42 days, and 1 horse for 36 days, is = 14·94 lbs. per day per horse.

	lbs.		d.
Average, per day per horse, grain mixture,	14·25,	costing	10·6
Do., do. hay,	14·94	,,	6·8
Total food and cost, per day, per horse, .	29·19	,,	17·4

The horses consumed per day each 1·19 lbs. of oil = 2·85 lbs. starch, 12·64 lbs. starch, and 1.59 lbs. albumen. The starch, and oil calculated as starch = 15·49 lbs., and contained 6·88 lbs. of carbon. The ratio between the nitrogenous and non-nitrogenous is as 1 to 9·7.

The above food caused, for about three weeks, a slight scouring; it has now disappeared, and there remains but a slight looseness. The excrements have an intolerable odour. The horses have not lost flesh; they continue in good condition, but there is no apparent gain of flesh.

From July 5 to August 17, the horses were fed on the mixture of Indian corn, oats, and bran, the same as was used from May 24 to July 4, and at the same prices; and 14 cwts. of hay, at *5s. 3d.* per 112 lbs., first crop clover and mixed grasses, growth of 1858. The analysis of this hay is distinguished by the letter E.

The following Table gives the dates of each weighing of food, the number of horses it kept, and the results as to quantity consumed, and work performed:—

Dates.		No. of Horses and Time.	Grain Mixture.			Average per day consumed.	Days.			Work performed.		
From	To		Indian Corn.	Oats.	Bran.		Total.	Worked.	Idle.	Total.	Per Worked Day.	Per Day for Whole Time.
			lbs.	lbs.	lbs.	lbs.				Tons.	Tons.	Tons
July 5,	July 12,	{2 for 8 days, 1 for 4 days,}	240	60	60	18·00	8	6	2	72½	4·53	3·63
July 13,	July 20,	2, whole time,	240	60	60	22·50	8	8	.	86¾	5·42	5·42
July 21,	July 30,	ditto,	240	60	60	18·00	10	5	5	33½	3·35	1·68
July 31,	Aug. 17,	ditto,	480	120	120	20·00	18	18	.	265¾	7·38	7·38
Totals and Averages,		{2 for 44 days, 1 for 4 days,}	1200	300	300	19·56	44	37	7	458½	5·88	4·98

The 14 cwts, of hay for the above time = 17 lbs. per day per horse. 2 horses for 44 days, and 1 horse for 4 days.

	lbs.		*d.*
Average, per day per horse, grain mixture,	19·56,	costing	14·45
Do., do. hay,	17·00	,,	9·56
Total food and cost, per day, per horse,	36·56	,,	24·01

The horses consumed in the above food per day each 1·54 lbs. of oil = 3·70 lbs. of starch, 15·24 lbs. of starch, and 2·37 lbs. of albumen. The starch, and oil calculated as starch = 18·94 lbs., and contained 8·41 lbs. of carbon. The ratio between the nitrogenous and non-nitrogenous is as 1 to 8.

The horses have improved very much this period; they are putting up flesh rapidly, although the work has been much increased. Their excrements have nearly lost the intolerable odour which I mentioned in the first period.

From August 18 to September 15, 1859, the horses were fed on a mixture of Indian corn and oats, the same sorts as used in the previous periods, and at the same prices.

The hay used from August 18 to August 27, was 336 lbs. of load E, which was consumed at the rate of 17 lbs. per day per horse; cost 5*s.* 3*d.* per 112 lbs. The hay used from August 28 to September 15, was 849 lbs. of load F, cost 5*s.* per 112 lbs., which was consumed at the rate of 22·34 lbs. per day, per horse.

The following Table gives the dates of each weighing of food, the number of horses it kept, and the result as to work, &c.:—

Dates.		No. of Horses and Time.	Grain Mixture.		Consumed per day.		Days.			Work performed.		
From	To		Indian Corn.	Oats.	Grain.	Hay.	Total.	Worked.	Idle.	Total.	Per Worked Day.	Per Day for Whole Time.
			lbs.	lbs.	lbs.	lbs.				Tons.	Tons.	Tons.
Aug. 18,	Aug. 27,	2 whole time,	240	120	18·0	17·0	10	8	2	130	8·12	6·50
„ 28,	Sept. 5,	2 „	240	120	20·0	22·34	9	6	3	125	10·41	6·94
Sept. 6,	Sept. 15.	2 „	240	120	18·0	22·34	10	6	4	114	9·50	5·70
Totals and Averages,		2 for 29 days,	720	360	18·62	20·43	29	20	9	369	9·22	6·36

	lbs.		*d.*
Average per day, per horse, of grain mixture,	18·62,	cost	15·20
Do., do. hay, . . .	20·43	„	11·10
Total food and cost, per day, per horse,	39·05		26·30

The horses consumed each, per day, in the above food, 1·72 lbs of oil = 4·13 lbs. starch, 16·57 lbs. starch, and 2·52 lbs. albumen.

The starch, and oil calculated as starch, = 20·70 lbs., and contain 9·20 of carbon. The ratio between the nitrogenous and non-nitrogenous constitutents is as 1 to 8·21.

The above feeding kept the horses in fine condition. It had a tendency to induce costiveness. The horses leave the very fine Indian corn meal, and eat only the oats and coarse portion of the Indian corn. The hay used from August 28 to September 15, was short and brittle—consequently wasteful.

From September 16 to November 3, 1859, the horses were fed on a mixture of Odessa Indian corn, Irish bran, and toppings; the Indian corn cost 31*s.* per 480 lbs.; the bran, 5*s.* per 112 lbs.; and the toppings, 4*s.* 6*d.* per 112 lbs. The analyses of these are marked 4, 5, and 6.

From September 16 to October 11, there were used 1251 lbs. hay, load F, cost *5s.*, averaging 22·34 lbs. per day per horse; from October 12 to November 3, there were used 1288 lbs. of load J of hay, at *4s.* 11*d.* per 112 lbs.; averaging 18·66 lbs. per day per horse.

The following Table gives the dates of each weighing of food, the number of horses it kept, and the result as to consumption, work, &c.:—

Dates.		No. of Horses and Time.	Grain Mixture.			Average per Day consumed.	Days.			Work performed.		
From	To		Indian Corn.	Bran.	Toppings.		Total.	Worked.	Idle.	Total.	Per Worked Day.	Per Day for Whole Time.
			lbs.	lbs.	lbs.	lbs.				Tons.	Tons.	Tons.
Sept. 16,	Sept. 26,	2 for 11 days,	240	60	60	16·36	11	6	5	54	4·50	2·45
Sept. 27,	Oct. 6,	2 for 10 days,	240	50	50	17·00	10	4	6	25	3·12	1·25
Oct. 7,	Oct. 13,	{ 2 for 7 days, 1 for 6 days, }	240	60	60	18·00	7	5	2	90	6·00	4·50
Oct. 14,	Oct. 24,	3 for 11 days,	480	112	112	21·33	11	11	.	384	11·63	11·63
Oct. 25,	Nov. 3,	3 for 10 days,	480	112	112	23 46	10	10	.	147	4·90	4·90
Totals and Averages,		{ 2 for 22 days, 3 for 27 days, }	1680	394	394	19·74	49	36	13	700	7·14	5·60

2539 lbs. of hay, as above, consumed by 2 horses, feeding for 22 days, and 3 horses, feeding for 27 days, averaged 20·24 lbs. per day per horse.

	lbs.		*d.*
Average per day, per horse, of grain mixture,	19·74,	cost	13·62
Do. do. hay, . . .	20.24,	,,	10·80
Total food, and cost per day, per horse,	39·98,		24·42

The horses consumed per day, each, in the above food, 2 lbs. of oil = 4·8 lbs. starch, 16·90 lbs. of starch, and 2·82 lbs. of albumen.

The starch, and oil calculated as starch = 21·70 lbs., and contain 9·64 lbs. of carbon. The ratio between nitrogenous and non-nitrogenous is as 1 to 7·7.

The horses have kept in fine condition during this period, excepting the first 11 days, when they looked cold and hairy.

From the 4th to the 15th November, 1859, the horses were fed on a mixture composed of Odessa yellow Indian corn and toppings, same sorts as were used in the last experiment, and at the same prices.

The balance, 672 lbs. of the load J of hay, was also eaten this period; it averaged 18·66 lbs. per day, per horse.

The following Table gives the particulars as to consumption, work, number of horses, &c. :—

Dates.		No. of Horses and Time.	Grain Mix.		Consumption per Day, Grain Mixture.	Consumption per Day of Hay.	Days.			Work performed.		
From	To		Indian Corn.	Toppings.			Total.	Worked.	Idle.	Total.	Per Worked Day.	Per Day for Whole Time.
			lbs.	lbs.	lbs.	lbs.				Tons.	Tons.	Tons.
Nov. 4,	Nov. 15,	3 for 12 days,	480	280	21·11	18·66	12	10	2	185	6·17	5·13
Totals and Averages		3 for 12 days,	480	280	21·11	18·66	12	10	2	185	6·17	5·13

	lbs.	d.
Average per horse, per day, of grain mixture,	21·11,	cost 14·08
Do. do. hay, . . .	18·66,	,, 9·83
Total food, and cost per day, per horse,	39·77,	23·91

The horses consumed each, per day, in the above feeding, 1·90 lbs. of oil = 4·56 lbs. starch, 17·16 lbs. starch, and 2·35 lbs. of albumen.

The starch, and oil calculated as starch = 21·72 lbs, which contain 9·65 lbs. of carbon. The ratio between the nitrogenous and non-nitrogenous constituents is as 1 to 9·24.

No change to notice in the horses during this period.

From November 18 to December 1, 1859, the horses were fed on a mixture of Galatz Indian corn and Irish bran. The Indian corn cost 34*s.* per quarter = £7 18*s.* 8*d.* per ton; the bran cost 6*s.* per 112 lbs. 744 lbs. of load K of hay, at 6*s.* 2*d.* per 112 lbs. The analysis of Galatz corn is marked 7.

The following Table furnishes particulars as to number of horses, quantity of food, and work performed:—

Dates.		No. of Horses and Time.	Grain Mix.		Consumption per Day, Grain Mixture.	Consumption per Day of Hay.	Days.			Work performed.		
From	To		Indian Corn.	Bran.			Total.	Worked.	Idle.	Total.	Per Worked Day.	Per Day for Whole Time.
			lbs.	lbs.						Tons.	Tons.	Tons.
Nov. 18,	Dec. 1,	3 for 14 days,	462	336	19·00	17·70	14	11	3	229	6·94	5·45
Totals and Averages,		3 for 14 days,	462	336	19·00	17·70	14	11	3	229	6·94	5·45

	lbs.	d.
Average per day, per horse, grain mixture,	19·00,	cost 14·47
Do. do. hay, . . .	17·70,	,, 11·69
Total food, and cost per day, per horse,	36·70	26·16

The horses consumed each, per day, in the above feeding, 1·25 lbs. of oil = 3 lbs of starch, 16·05 lbs. starch, and 3 lbs of albumen.

The starch, and oil calculated as starch = 19·05 lbs., and contain 8·46 lbs. carbon. The ratio between the nitrogenous and non-nitrogenous is as 1 to 6·35.

The horses work, and look well, on this feeding; it passes rather quickly through their stomachs; some of it, undigested, being noticeable in their excrements.

From December 2 to December 14, 1859, the horses were fed on a mixture composed of Galatz Indian-corn, bran from Irish wheat, and toppings. The Indian corn cost 34*s.* per qr. of 480 lbs.; the bran 6*s.* per 112 lbs.; and the toppings 4*s.* per 112 lbs.; and 690 lbs. hay, load K, at 6*s.* 2*d.* per 112 lbs. The analysis is marked 9.

The following Table furnishes particulars as to the number of horses kept, quantity of food used, and work performed:—

Date.		No. of Horses and Time.	Grain Mixture.			Grain Mixture per Day.	Hay per Day.	Days.			Work performed.		
From	To		Indian Corn.	Bran.	Toppings.			Total.	Work.	Idle.	Total.	Per Worked Day.	Per Day for Whole Time.
			lbs.	lbs.	lbs.	lbs.	lbs.				Tons.	Tons.	Tons.
Dec. 2,	Dec. 14,	3 for 13	462	224	112	20·46	17·70	13	10	3	247	8·23	6·33
Totals and Averages,		3 for 13	462	224	112	20·46	17·70	13	10	3	247	8·23	6·33

	lbs.	*d.*
Average per day, per horse, grain mixture, .	20·46, cost	15·15
Do., do., hay, ...	17·70 ,,	11·69
Total food and cost per horse, per day,	38·16	26·84

The horses consumed each, per day, in the above feeding, 1·21 lbs. of oil = 2·91 starch, 16·53 lbs of starch, and 2·88 lbs. of albumen. The starch, and oil calculated as starch, = 19·44 lbs., and contain 8·64 lbs. of carbon. The ratio between the nitrogenous and non-nitrogenous constituents is as 1 to 6·75.

The horses continue in prime order.

From December 15, 1859, to February 1, 1860, the horses were fed on a mixture composed of Galatz Indian corn, Irish bran, toppings, and rape-cake meal. The Indian corn, bran, and toppings, at the prices stated for last period. The rape-cake meal at 7*s.* per 112 lbs. The analysis of rape-cake is marked 9.

3696 lbs. of hay, load L, were used during the above period; it cost 6*s.* per 112 lbs.; 2nd crop clover and grasses, growth of 1859; its consumption averaged 25·11 lbs. per day, per horse.

The following table furnishes particulars as to the dates of each weighing of food, the number of horses kept, work performed, &c. :—

Dates. From	Dates. To	No. of Horses and Time.	Grain Mixture. Indian Corn.	Grain Mixture. Bran.	Grain Mixture. Toppings.	Grain Mixture. Rape Cake	Average per Day Grain Mixture.	Days. total.	Days. Worked.	Days. Idle.	Work performed. Total	Work performed. Per Worked Day.	Work performed. Per Day for Whole
			lbs.	lbs	lbs.	lbs.	lbs.				Tons.	Tons.	Tons.
Dec. 15,	Dec. 28,	3 for 14	252	112	112	56	12·66	14	9	5	83	3·07	2·00
„ 29,	1860. Feb. 1,	3 for 35	294	560	224	112	11·32	35	30	5	516	5·73	4·91
Totals and Averages,		3 for 49	546	672	336	168	11·71	49	39	10	599	5·12	4·07

	lbs.		*d.*
Average per day, per horse, grain mixture,	11·71,	cost	8·06
Do. do. hay, . . .	25·11,	„	16·14
Total food, and cost per day, per horse,	36·82,		24·20

The horses consumed each, per day, 1·14 lbs. oil = 2·74 lbs. of starch, 11·12 lbs. starch, and 2·67 lbs. of albumen.

The starch, and oil calculated as starch = 13·86 lbs., and contain 6·16 lbs. of carbon. The ratio between the nitrogenous and non-nitrogenous constituents is as 1 to 5·20.

During the above time the weather was very severe, and roads bad. I believe that under the circumstances five tons per day is much harder work than 6 tons 5 cwt. in fine weather, when the roads are good and the days long.

5 tons = 4 loads. 6 tons 5 cwt. = 5 loads.

The horses got thin this period; they lost the flesh they put up in July, August, and September.

COMPARISON.

Dates.	Oil 10 = 24 Starch.	Starch as such.	Total Oil and Starch calculated as Starch.	Carbon in Food	Albumen.	Ratio of Plastic to Non-Nitrogen.	Tons per Day Worked.	Tons per Day, all Time.
May 24 to July 4, . .	1·19 = 2·85	12·64	15·49	6·88	1·59	1 : 9·70	6·86	3·26
July 5 to Aug. 17, . .	1·54 = 3·70	15·24	18·94	8·41	2·37	1 ; 8·00	5·88	4·98
Aug. 18 to Sept. 15, .	1·72 = 4·18	16·75	20·70	9·20	2·52	1 : 8·21	9·22	6·36
Sept. 16 to Nov. 3, .	2·00 = 4·80	16·90	21·70	9·64	2·82	1 : 7·70	7·14	5·60
Nov. 4 to Nov. 15, .	1·90 = 4·56	17·16	21·72	9·65	2·35	1 : 9·24	6·17	5·13
Nov. 18 to Dec. 1, . .	1·25 = 3 00	16·05	19·05	8·46	3·00	1 : 6·35	6·94	5·45
Dec. 2 to Dec. 14, . .	1·21 = 2·91	16·53	19·44	8·64	2·88	1 : 6·75	8·23	6·33
Dec. 15 to Feb. 1, . .	1·14 = 2·74	11·12	13·86	6·16	2·67	1 : 5·20	5·12	4·07

1. Irish black oats (growth of 1858), weighing 39 lbs. per bushel; price 15*s.* 6*d.* per 196 lbs.; used in the feeding experiments from May 24 to September 15, 1859.

	Analyses. I.	Analyses. II.	Mean.
Water, ...	11·41	11·83	11·62
Albuminous compounds (flesh-forming matters), ...	7·60	7·91	7·75
Oil, starch, sugar, &c., { fat and heat producing materials, }	5·92	5·86	5·89
	42·67	42·04	42·36
Fibre (indigestible), ...	29·84	29·40	29·62
Ash (inorganic matter), ...	2·56	2·96	2·76
	100·00	100·00	100·00
Nitrogen, . . .	1·21	1·26	1·235

Hay D, 1st crop clover and mixed grasses (growth 1858), 16 cwt., at 4*s.* 3*d.* per 112 lbs. Used in the feeding experiments from May 24 to July 4.

	Analyses. I.	Analyses. II.	Mean.
Water, ...	11·66	11·08	11·37
Albuminous compounds (flesh-forming matters), ...	3·66	4·57	4·12
Oil, { fat and heat producing	3·44	3·62	3·53
Starch, materials. }	27·76	27·61	27·68
Fibre (indigestible), ...	45·98	46·06	46·02
Ash (inorganic matter)	7·50	7·06	7·28
	100·00	100·00	100·00
Nitrogen, . . .	0·582	0·727	0·65

100 grains of the hay D, which had been dried at 212° F., weighed 75·75 grains after it had been digested in water for 24 hours, and subsequently dried at 212° F.; 24·25 per cent. of this hay was therefore soluble in water.

	Composition of the Hay not digested, but dried at 212° F.	Composition of the digested Hay, dried at 212° F.
Albuminous compounds, . .	4·65	5·32
Ash, ...	8·21	3·93
Fibre, ...	51·92	51·92
Oil, ...	3·98 }	14·58
Starch, sugar, &c., ...	31·23 }	
	99·99	75·75
Amount of matter in the hay soluble in water, . .		24·25
		100·00

2. Flat yellow American Indian corn, weighing 56½ lbs. per bushel; price 30*s.* per 480 lbs. = £7 per ton. Used in the feeding experiments from May 24 to September 15, 1859.

	Analyses. I.	Analyses. II.	Mean.
Water,	13·60	13·60	13·60
Albuminous compounds (flesh-forming matters),	5·82	6·30	6·06
Oil, } fat and heat producing materials,	4·38	4·38	4·38
Starch, } fat and heat producing materials,	70·08	69·54	69·81
Fibre (indigestible),	4·82	4·68	4·75
Ash (inorganic matter),	1·30	1·50	1·40
	100·00	100·00	100·00
Nitrogen,	0·926	1·003	0·964

3. Bran from Black Sea wheat, weighing 18·9 lbs. per bushel, price 4*d.* 6*d.* per 112 lbs. Used in the feeding experiments from May 24 to August 17, 1859.

	Analyses. I.	Analyses. II.	Mean.
Water,	12·16	11·97	12·07
Albuminous compounds (flesh-forming matters),	8·80	9·37	9·08
Oil, } fat and heat producing materials.	4·04	4·38	4·21
Starch, } fat and heat producing materials.	37·04	35·94	36·49
Fibre (indigestible),	30·26	30·86	30·56
Ash (inorganic matter),	7·70	7·48	7·59
	100·00	100·00	100·00
Nitrogen,	1·40	1·49	1.445

Hay E, 1st crop (growth of 1858), clover and mixed grasses; 17 cwt., price 5*s* 3*d.* per 112 lbs. Used in the feeding experiments from July 5 to August 27.

	Analyses. I.	Analyses. II.	Mean.
Water,	9·89	9·70	9·79
Albuminous compounds (flesh-forming matters),	5·98	6·15	6·07
Oil, } fat and heat producing materials,	3·60	3·98	3·79
Starch, } fat and heat producing materials,	21·41	21·11	21·26
Fibre, (indigestible),	51·08	51·10	51·09
Ash (inorganic matter),	8·04	7·96	8·00
	100·00	100·00	100·00
Nitrogen,	0·952	0·98	0·961

100 grains of the hay E, which had been dried at 212° F., weighed 77·19 grains after it had been digested in water for 24 hours, and subsequently dried at 212° F.; 22·81 per cent. of this hay was therefore soluble in water.

	Composition of the Hay not digested, but dried at 212° F.	Composition of the digested Hay dried at 212° F.
Albuminous compounds, . .	6·73	6·78
Ash, ...	8·86	4·29
Fibre, ...	56·63	56·63
Oil, ...	4·20	9·49
Starch, sugar, &c., ...	23·57	
	99·99	77·19
Amount of matter in this hay soluble in water, . .		22·81
		100·00

Hay F, 2nd crop (growth 1859), clover and mixed grasses, 18¾ cwt., at 5*s.* per 112 lbs. Used in feeding from August 28 to October 11, 1859.

	Analyses. I.	Analyses. II.	Mean.
Water, ...	12·35	12·40	12·38
Albuminous compounds (flesh-forming matters), ...	6·15	6·59	6·37
Oil, {fat and heat producing	4·12	4·00	4·06
Starch, materials,}	27·68	27·61	27·64
Fibre (indigestible), ...	43·34	42·82	43·08
Ash (inorganic matter), ...	6·36	6·58	6·47
	100·00	100·00	100·00
Nitrogen, . . .	0·98	1·05	1·01

100 grains of the hay F, which had been dried at 212° F., weighed 74·74 grains after it had been digested in water for 24 hours, and subsequently dried at 212° F.; 25·26 per cent. of this hay was therefore soluble in water.

	Composition of the Hay not digested, but dried at 212° F.	Composition of the digested Hay, dried at 212° F.
Albuminous compounds, . .	7·27	6·57
Ash, ...	7·28	3·52
Fibre, ...	49·16	49·16
Oil, ...	4·63	15·49
Starch, sugar, &c., ...	31·65	
	99·99	74·74
Amount of matter in the hay soluble in water, .		25·26

4. Odessa round yellow Indian corn, weighing 61⅛ lbs. per bushel; price, 31*s*. per 480 lbs. = £7 4*s*. 8*d*. per ton. Used in feeding from Sept. 16 to November 15, 1859.

	Analyses. I.	Analyses. II.	Mean.
Water,	12·23	11·74	11·98
Albuminous compounds (flesh-forming matters),	9·37	8·80	9·09
Oil, {fat and heat producing materials, }	6·78	6·38	6·58
Starch,	65·30	66·02	65·66
Fibre (indigestible),	5·08	5·78	5·43
Ash (inorganic matter),	1·24	1·28	1·26
	100·00	100·00	100·00
Nitrogen,	1·49	1·40	1·445

Hay J, first crop, clover and grasses; growth 1859; 17½ cwts., at 4*s*. 11*d*. per cwt. Used in feeding experiments from October 12 to November 14.

	Analyses. I.	Analyses. II.	Mean.
Water,	15·93	15·40	15·66
Albuminous compounds (flesh-forming materials)	4·40	5·27	4·83
Oil, {fat and heat producing materials, }	3·94	3·78	3·86
Starch,	27·53	28·67	28·11
Fibre (indigestible),	42·44	41·46	41·95
Ash (inorganic),	5·76	5·42	5·59
	100·00	100·00	100·00
Nitrogen,	0·70	0·84	0·77

100 grains of the hay J, which had been dried at 212° F, weighed 85·26 grains after it had been digested in water for 24 hours, and subsequently dried at 212° F; 14·74 per cent. of this hay was therefore soluble in water.

	Composition of the Hay not digested, but dried at 212° F.	Composition of the digested Hay, dried at 212° F.
Albuminous compounds,	5·74	5·80
Ash,	6·63	3·72
Fibre,	49·62	49·62
Oil,	4·57	26·12
Starch, sugar, &c.,	33·43	
	99·99	85·62
Amount of matter in the hay soluble in water,		14·74
		100·00

5. Irish wheat bran, weighing 18 lbs. per bushel; price 5*s.* per 112 lbs. Used in feeding experiments from September 16, 1859, to February 1, 1860.

	Analyses. I.	Analyses. II.	Mean.
Water,	11·68	11·57	11·62
Albuminous compounds (flesh-forming matters),	11·72	11·72	11·72
Oil, } fat and heat producing materials,	5·96	5·94	5·95
Starch, } fat and heat producing materials,	35·86	35·81	35·84
Fibre (indigestible),	29·44	29·58	29·51
Ash (inorganic matter),	5·34	5·38	5·36
	100·00	100·00	100·00
Nitrogen,	1·86	1·86	1·86

6. New toppings from oats (growth 1859), weighing 17·44 lbs. per bushel; price 4*s.* 6*d.* per 112 lbs. Used in the feeding experiments from September 16 to December 2, 1859.

	Analyses. I.	Analyses. II.	Mean.
Water,	9·64	9·42	9·53
Albuminous compounds (flesh-forming matters),	3·22	2·93	3·07
Oil, } fat and heat producing materials,	3·80	3·98	3·89
Starch, } fat and heat producing materials,	40·36	40·63	40·50
Fibre (indigestible),	39·90	40·02	39·96
Ash (inorganic matter),	3·08	3·02	3·05
	100·00	100·00	100·00
Nitrogen,	0·513	0·467	0·49

Hay K, 2nd crop (growth 1859), clover and meadow grass, 13¾ cwt., at 6*s.* 2*d.* per cwt. Used in feeding from November 15 to December 14, 1859.

	Analyses. I.	Analyses. II.	Mean.
Water,	12·30	11·60	11·95
Albuminous compounds (flesh-forming matters),	5·98	6·33	6·16
Oil, starch, } fat and heat producing materials,	1·66	1·48	1·57
sugar, &c., } fat and heat producing materials,	33·00	33·73	33·36
Fibre (indigestible),	40·12	40·06	40·09
(inorganic matter),	6·94	6·80	6·87
	100·00	100·00	100·00
Nitrogen,	0·952	1·008	0·98

100 grains of the hay K, which had been dried at 212° F., weighed 85·79 grains after it had been digested in water for 24 hours, and subsequently dried at 212° F.; 14·21 per cent. of this hay were therefore soluble in water.

	Composition of the Hay not digested, but dried at 212° F.	Composition of the digested Hay, dried at 212° F.
Albuminous compounds, . .	6·99	5·80
Ash, ...	7·80	4·67
Fibre, ...	45·53	45·53
Oil, ...	1·78	29·79
Starch, ...	37·88	
	99·98	85·79
Amount of matter in this hay soluble in water, . .		14·21
		100 00

7. Moldavian round yellow Indian corn from Galatz, weighing 61½ lbs. per bushel; price, 34*s.* per 480 lbs. = £7 18*s.* 8*d.* per ton. Used from November 18, 1859, to February 1, 1860.

	Analyses. I.	Analyses. II.	Mean.
Water, ...	13·23	12·86	13·04
Albuminous compounds (flesh-forming matters), ...	8·58	9·24	8·91
Oil, (fat and heat producing materials)	4·54	4·58	4·56
Starch, (fat and heat producing materials)	66·59	66·16	66·38
Fibre (indigestible), ...	5·72	5·80	5·76
Ash (inorganic matter), ...	1·34	1·36	1·35
	100·00	100·00	100·00
Nitrogen, . . .	1·36	1·47	1·41

8. Irish rape-cake meal, 1½ cwt., at 7*s.* per cwt. Used in feeding from December 15, 1859, to February 1, 1860.

	Analyses. I.	Analyses. II.	Mean.
Water, ...	10·20	10·00	10·10
Albuminous compounds (flesh-forming matters, ...	32·24	31·36	31·80
Oil, (fat and heat producing materials)	11·30	10·64	10·97
Starch, (fat and heat producing materials)	14·98	16·86	15·92
Fibre (indigestible), ...	23·42	23·40	23·41
Ash (inorganic matter), ...	7·86	7·74	7·80
	100·00	100·00	100·00
Nitrogen, . . .	5·13	4·99	5·06

9. Toppings from Irish oats (growth of 1859), weighing 13 lbs. per bushel; price, 4*s*. per 112 lbs. Used from December 2, 1859, to February 1, 1860.

	Analyses. I.	Analyses. II.	Mean.
Water,	9·02	8·99	9·01
Albuminous compounds (flesh-forming matters),	2·20	2·20	2·20
Oil, } fat and heat producing materials,	1·94	1·98	1·96
Starch, } fat and heat producing materials,	24·90	24·37	24·63
Fibre (indigestible),	58·46	59·16	58·81
Ash (inorganic matter),	3·48	3·30	3·39
	100·00	100·00	100·00
Nitrogen,	0·35	0·35	0·35

Hay L, 2nd crop, clover and mixed grasses, growth of 1859; 33 cwt., at 6*s*. per 112 lbs. Used in feeding from December 15, 1859, to February 1, 1860.

	Analyses. I.	Analyses. II.	Mean.
Water,	12·93	12·86	12·89
Albuminous compounds (flesh-forming matters),	5·27	5·85	5·56
Oil, starch, } fat and heat producing materials,	1·70	1·45	1·57
sugar, &c., } fat and heat producing materials,	24·32	25·60	24·97
Fibre (indigestible),	49·32	48·26	48·79
Ash (inorganic matter),	6·46	5·98	6·22
	100·00	100·00	100·00
Nitrogen,	0·84	0·93	0·88

100 grains of the hay L, which had been dried at 212° F., weighed 84·93 grains after it had been digested in water for 24 hours, and subsequently dried at 212° F.; 15·07 per cent. of this hay was therefore soluble in water.

	Composition of the Hay not digested, but dried at 212° F.	Composition of the digested Hay, dried at 212° F.
Albuminous compounds,	6·38	6·34
Ash,	7·14	4·22
Fibre,	56·01	56·01
Oil,	1·80	1·58
Starch, sugar, &c.,	28·67	16·78
	100·00	84·93
Amount of matter in the hay soluble in water,		15·07
		100·00

In Table I., I have calculated the mileage from known data: the return journey is not included in the calculation, as the horses simply returned with the empty carts.

The cost per single ton I have made out, as it shows at one glance whether it would be cheaper to employ horses, or to keep them. If we wish to employ horses, the charge is 1*s.* 8*d.* per ton; but, if we keep them, the cost is about 1*s.* 0¾*d.* per ton—viz., 7*d.* for the driver, 4¾*d.* for the food, and 1*d.* for repairs of harness, cart, and rent.

From this statement, it would seem that the keepers of horses had a direct profit of about 7¼*d.* per ton. Now, in reality, they have no such gain, as I have not, as may be perceived, noticed the depreciation in value of horses (which are bought young, and at a high price, and sold, after some time, at a reduced price), nor the interest of the money invested in the horses and carts.

In Table II., the quantities under the head *constant* are the amounts of albumen and carbon required to support the animal in idleness. What is given in excess of this quantity is expended in labour; and if not spent in the production of power, it goes to stock, or, in other words, is accumulated labour.

The constants were arrived at in the following manner:—From July 5 to Aug. 17, the horses consumed each per day 2·37 lbs. of albumen, and 8·41 lbs. of carbon, and carted out each per day 4·98 tons of goods. In the previous period, from May 24 to July 4, the horses consumed each per day 1·59 lbs. of albumen, and 6·88 lbs. of carbon, and carted out each per day 3·25 tons of goods. Now, if we deduct the tons and the albumen and carbon of the last-mentioned period—May 24 to July 4—from the first-mentioned period—July 5 to Aug. 17,—we obtain the difference in work and in the quantities of albumen and carbon consumed in the two periods. Thus:—

Tons.	Albumen.	Carbon.	
4·98	2·37	8·41. . . .	July 5 to Aug. 17.
3·26	1·59	6·88. . . .	May 24 to July 4.
1·72	0·78	1·53	

If the increased quantity, 1·72 tons, in the second period, requires 0·78 lbs. of albumen and 1·53 lbs. of carbon, 3·26 tons will require 1·47 lbs. of albumen and 2·91 lbs. of carbon. Now the difference between the quantities of albumen and carbon consumed per day in the period—May 24 to July 4,—and the quantities of albumen and carbon required by 3·26 tons per day—the work done in the period, gives us the quantity required by the animal in idleness:—

	Albumen.	Carbon.
	1·59 lbs.,	6·88 lbs.,
3·26 tons	1·47 ,,	2·91 ,,
Constants =	0·12 lbs.,	3·97 ,,

In that part of Table No. II. headed "Quantities," I have placed side-by-side the quantities of albumen and carbon required for the amounts of work placed before them, as found by experiment and by calculation. The quantities by experiment, with the *constants* added, give the actual quantities consumed. The calculated quantities, with the *constants* added, give the theoretical quantities.

In this Table, the experimental and calculated quantities agree very closely: there are but two periods where the difference is in any way large. This difference may be due to waste of food, in one case; and in the other, to the work being of a lighter kind.

As an additional proof of the constant quantities required for the animals' existence, and the quantities required for work, I have calculated the averages in Table No. II., and obtained the following results:—

If 3·26 tons require 1·47 lbs. of albumen, and 2·91 lbs. of carbon, 5·15 tons require

	Albumen.	Carbon.
By Calculation, ...	2·32 lbs.,	4·60 lbs.,
,, Experiment, ...	2·40 ,,	4·41 ,,
,, Average, ...	2·32 ,,	4·58 ,,

From this it is easy to perceive why the horses got thin; as on the average of the whole time, they required, by calculation, 4·60 lbs. of carbon, and got but 4·41 lbs., for each quantity of 5·15 tons of goods worked.

From these experiments, it appears that when food contains albumen and non-nitrogenous matters in the proportion of 1 to 8, or 1 to 10, it is best adapted for work-horses. When the albumen is in greater proportion than 1 to 8, there is a waste of it.

By these experiments and calculations, it appears that a horse requires per day in idleness about 64 oz. of carbon and 2 oz. of albumen; and as we give no food containing such a small proportion of albumen, the animal, although not gaining in fat, must gain in flesh or muscle.

The quantities of albumen and carbon required for each day's consumption is the sum of the *constants*, and the quantities required for work.

I have been told that the army horses get but 10 lbs. of hay and 10 lbs. of oats per day, both articles being of an inferior description. If this be true, it goes far to support my idea of a constant quantity.

Any discrepancies there may be between the experimental and calculated quantities may be accounted for by one or all of the following causes:—

1. Waste of food;

2. Inequality of roads travelled, with regard to incline and traction;

3. State of the weather; which lessens or increases traction, and, consequently, the labour.

TABLE No. I.

Dates.	Days.	Food per Day.				Totals.		Tons per Day.	Average Mileage per Ton.	Total Miles per Ton.	Cost per Ton, per Mile.	Cost per Single Ton.	Observations.
		Grain.	Cost.	Hay.	Cost.	Food.	Cost.						
		lbs.	Pence.	lbs.	Pence.	lbs.	Pence.				Pence.	Pence.	
May 24, to July 4,	42	14·25	10·60	14·94	6·80	29·19	17·40	3·26	2·56	8·35	2·08	5·34	No improvement nor deterioration.
July 5, to Aug. 17,	44	19·56	14·45	17·00	9·56	36·56	24·01	4·98	,,	12·75	1·88	4·82	Decided improvement.
Aug. 18, to Sep. 15,	29	18·62	15·20	20·43	11·10	39·05	26·30	6·36	,,	16·28	1·61	4·13	No change.
Sept. 16, to Nov. 3,	49	19·74	13·62	20·24	10·80	39·98	24·42	5·60	,,	14·34	1·70	4·36	Ditto.
Nov. 4, to Nov. 15,	12	21·11	14·08	18·66	9·83	39·77	23·91	5·13	,,	13·13	1·82	4·66	Ditto.
Nov. 18, to Dec. 1,	14	19·00	14·47	17·70	11·69	36·70	26·16	5·45	,,	13·95	1·87	4·80	Ditto.
Dec. 2, to Dec. 14,	13	20·46	15·15	17·70	11·69	38·16	26·84	6·33	,,	16·20	1·65	4·24	Ditto.
Dec. 15, to Feb. 1,	49	11·71	8·06	25·11	16·14	36·82	24·20	4·07	,,	10·42	2·32	5·94	Lost flesh; food deficient in carbon.
Averages, . . .	. .	. .	. .	. .	. .	. .	. .	5·15	. .	. .	1·86	4·78	

TABLE No. II.

Dates.	Constant.*		Tons per Day.	Quantities.				Food Grain.	Observations.
				Experiment.		Calculation.			
	Albumen.	Carbon.		Albumen.	Carbon.	Albumen.	Carbon.		
	lbs.	lbs.		lbs.	lbs.	lbs.	lbs.		
May 24, to July 4,	0·125	3·975	3·26	1·47	2·91	1·47	2·91	Indian corn, bran, and oats.	There are but two periods where the discrepancy between the quantity of albumen, found by experiment and calculation, are any way large; this may arise, in the first instance, Aug. 17, to Sept. 15, from the work being light; and, in the second, from Nov. 18, to Dec. 1, from waste of food. From Dec. 15, to Feb. 1, the food was deficient in carbon, and the horses got poor. If the work for this period was calculated as per foot note, p. 10, there would be no discrepancy in the albumen quantities.
July 5, to Aug. 17,	0·125	3·975	4·98	2·24	4·44	2·24	4·44	Ditto.	
Aug. 18, to Sept. 15,	0·125	3·975	6·36	2·40	5·23	2·86	5·66	Indian corn and oats.	
Sept. 16, to Nov. 3,	0·125	3·975	5·60	2·70	5·67	2·52	5·00	Indian corn, bran, and toppings.	
Nov. 4, to Nov. 15,	0·125	3·975	5·13	2·23	5·68	2·81	4·57	Indian corn and toppings.	
Nov. 18, to Dec. 1,	0·125	3·975	5·45	2·88	4·49	2·46	4·85	Indian corn and bran.	
Dec. 2, to Dec. 14,	0·125	3·975	6·33	2·76	4·67	2·85	5·64	Indian corn, bran, and toppings.	
Dec. 15, to Feb. 1,	0·125	3.975	4·07	2·55	2·19	1·88	3·62	Indian corn, bran, toppings, and rape cake.	
Averages, ...	. .	. .	5·15	2·40	4·41	2.82	4·58	5·15 tons × 2·56 miles = 1 ton 13·18 miles. The cartage of 1 ton, 1 mile, would cost 2·91. oz. of albumen, and 5·60 oz. carbon.	

* These are the quantities required to support the animal in idleness.

XVIII.—Brief Notices of a Botanical and Horticultural Tour made through portions of Germany, Holland, and Belgium, in the Autumn of 1860. By D. Moore, F. L. S., &c., Curator of the Botanic Garden.

[Read before the Royal Dublin Society, on Monday, January 28, 1861.]

In giving the following brief notices on matters of botanical and horticultural interest, connected with a tour I made last autumn through portions of some Continental countries, I shall be better able to connect the details by simply following the route taken on that occasion. Leaving Hull by steamer for Hamburgh, the Elbe was reached after experiencing a very rough passage of two nights and three days' duration. The shores of that important river, as seen at a distance when passing along in the steam-vessel, do not appear very inviting to inhabitants of undulating countries. Both Danish and Hanoverian sides are low, rising very little above the bed of the river; and the consequence is, that extensive reaches of strong-growing aquatic plants form broad margins along the banks for many miles together, occasionally extending a considerable distance inland. The principal sorts appeared to be our common bullrush, *Scirpus lacustris*, *Scirpus maritimus*, and the ubiquitous reed grass, *Phragmites communis*, all of which are useful plants in those countries. Their creeping roots bind the loose soil firmly on the banks of rivers, canals, &c., and thereby prevent it from being washed away by the agitated waters. They are also of some value in an economic point of view, as the bullrush is there manufactured into various articles of furniture, which is also the case in this country. After Cruxhaven is passed, the country appears to improve, both in fertility and cultivation, with many comfortable-looking farm-buildings visible, until Hamburgh is approached, when the Danish side becomes particularly picturesque. A series of undulating hills, with fertile valleys intervening, line the shore for several miles, the faces of which are thickly covered with handsome villas, many of them on a scale of splendour seldom seen near Continental cities.

My first visit after arriving was to the Botanic Garden, which is situate in the immediate vicinity of the city. The Inspector, M. Otto, received me with much cordiality; and Saturday being a leisure day with him, he kindly proposed to accompany me to some of the best plant gardens and nurseries in the neighbourhood, which I gladly agreed to. We accordingly went to the villa residence of M. Schiller, near Altona, who possesses one of the best private collections of plants I know of anywhere. I question much if there be one in England to surpass it, either for extent, value of plants, or high state of culture they present. The proprietor was in Switzerland at the time; but his gardener, M. Stange, conducted us through the numerous conservatories, where I observed many rare plants, among which were several I had not previously seen.

One large house was wholly occupied with the best sorts of varie-

gated-leaved Begonias, and a few other conspicuous plants interspersed among them, the whole forming quite a picture of beautiful foliage, as well as a perfect specimen of good cultivation. The following named sorts were rather remarkable among the mass:—*Madam Schiller*, *Bossier*, *Prince Troubetskoy*, and *bullata*. Not a decaying or blotched leaf was visible on one of them, which is rarely the case in groups of this sort; and on considering the matter afterwards, it occurred to me the perfection they were in might be partly owing to the conservatory being roofed with double sashes, which would prevent the external moisture from entering so readily, as well as the internal vapour from condensing, so as to fall in drops from the roof. Among the orchids were many rare kinds, and I have seldom seen so large a number in bloom in one establishment at the same time. Four, if not five, species of *Phalænopsis* were flowering, and among them the rare *Phalænopsis Schilleriana*, which I had not previously seen; another curious plant, named in honour of the same gentleman, viz., *Silenopodium Schilleriana;* also, *Miltonia Regnelia, Masdevalia maculata, Epidendrum glumaceum, Pescatorea cornuta, Dendrochilum arachnoideum, Trichopilia suavis, Stanhopia ecornuata*, &c. The species of *Vanda*, Aerides, and Saccolabium, were both numerous and fine.

Our next visit was to the extensive nursery establishment of the Messrs. Booth, through which one of the gentlemen kindly accompanied us. These nurseries are well known and famed through most parts of Europe, for extent of ground occupied, great collections of hardy and tender plants, as well as for the manner they are conducted. The collections of ferns, orchids, and cacti were good, and comprised a number of rare kinds. There were also some of the best plants of *Nepenthes sanguinea* I have seen, along with such other sorts of pitcher plants as are only found in a few nurseries. The assortment of hardy ornamental trees is extensive; and although many having distinct nursery names are only varieties of well-known species, they are different in their appearance, and interesting as such. I observed good plants of *Quercus lyrata, Quercus pubescens, Quercus coccinea*, variety *dissecta; Tilia Europæa*, variety *asplenifolia*, and variety *spicata; Cerasus Mahaleb*, variety *monstrosa, Cerasus asplenifolia, Caragana jubata, Robinia revoluta, Salisburia adiantifolia*, variegata, *Cercis siliquestrum variegatum; Morus macrophylla, Morus urticifolia, Fraxinus discolor*, weeping walnut, and weeping thorn, along with many others still rare in this country. A handsome specimen of the weeping deciduous cypress, *Taxodium distichum*, variety *pendulum*, stood near Mr. Booth's residence. It was of a pyramidal form, and about twenty feet high, well clothed with branches. Another pretty tree, much used for ornamental purposes through the North of Germany, stood near the cypress, the upright variety of elm, known under the name of *Ulmus oxoniensis*.

By appointment I again met M. Otto at the Botanic Gardens, for the purpose of making lists of plants for exchange, and where I found an extensive collection of both hardy and tender kinds. The ranges of conservatories, though such as would be considered clumsy in Eng-

land, are rather extensive, and probably well suited for affording protection to plants where the climate is rigorous during winter. Some fine specimens of Cycadaceous plants occupied places on their benches at the time I visited, and also a number of good palms. The tropical aquarium, in which plants of *Victoria regina* are cultivated, is a commodious structure, and the collection of stove aquatics numerous, particularly in species of Nymphæa, some of which were then in flower. The herbaceous plants are arranged according to the Linnean system, and rather extensive. Although much frequented by the inhabitants of Hamburgh, and sales of plants made to support the funds, still the scientific character of the garden is well kept up, whilst the more ornamental department is not neglected.

Taking leave of my kind friend Otto, I went by rail to Berlin, which, for the most part, passes through a series of extensive flat, sandy plains. From the windows of the carriage I could observe several plants which are either strangers to the British Flora, or rarely met with in this country. The sandy banks in many places were yellow with the flowers of *Helichrysum arenarium*; and *Cichorium Intybus*, with *Gentiana Pneumonanthe*, are also common plants there. Among the cultivated crops was one I had not previously seen, namely, the succulent yellow lupin, *Lupinus succulentus*, which is grown extensively in some parts of Germany, and appears to delight in the poor sandy soils on which it is generally cultivated. The appearance produced by the golden yellow flowers of this plant in such masses is very beautiful. It then occurred to me that this lupin might prove of considerable value for cultivating on the light sandy soils which abound so extensively in many parts round the sea-board of this country, and are now producing little else except bent. At any rate, it would surely be worth a trial; but in doing so, the seeds would require to be sown early, after the frosts have passed, in order that the plants may have all the advantage of the growing season; for when experimenting on crops which grow well on the Continent, it ought to be kept in view that although the mean annual temperature of those countries may be only equal to that of our own, the heat there is much greater during summer than it is here, and the winters colder. On making further inquiry about the lupin crop, I learned that the farmers grow it in many instances for the purpose of ploughing it in green as manure into the land, on which other crops are to be raised.

At the Berlin Botanic Garden I was politely and kindly received by the Inspector, M. Bouché, who conducted me though the establishment, and enabled me to make memoranda for exchange of plants, which has since been effected. One of the principal objects of attraction in this garden is the great new palm-house, which was lately built, and is now occupied with fine plants. It is 170 feet long by 54 high and 50 wide, covered with ridge and furrow roof in double sashes. It is heated by both steam and hot water. The former is generated from boilers placed underground, and chiefly used for the purpose of supplying bottom heat to the plants, the largest of which are

placed on hollow pillars to which the steam has access. It can also be admitted to the body of the house through apertures, so as to render the atmosphere as moist as a vapour bath, or shut off at pleasure by closing the apertures. Judging from the appearance of the plants, they like the treatment they are subjected to. Long adventitious roots were, in many instances, protruding from the stems of some palms, and many species of other plants; thus affording proof of the damp atmosphere they are grown in. It would be impossible, as well as undesirable, in a brief notice like the present, to mention a tithe of the old and interesting plants to be observed in the Berlin collection. I shall, therefore, confine my observations to a few of the more remarkable kinds. The number and size of the tree ferns are features most likely to attract the notice of English visitors; and the following rough measurements of a few will give some idea of their dimensions:—*Cyathea aurea*, with stem about 20 feet high; *Hemitelia integrifolia*, stem 5 feet; *Alsophila obtusa*, stem 15 feet, with several others of great size, among which are *Alsophila inermis*, *Angiopteris longifolia*, *Pteris castaneanus*, *Diplazium grandifolium*, and *Cyathea Mexicana*. Next in interest, according to my estimation, were the numerous species of Pandanæ, some of which form such grotesque figures when large. *Pandanus utilis* was full of fruit, which are singular looking black globular masses; and *Pandanus furcatus* was also in flower, as were some of the species of *Cyclanthus* and *Carludovica*. Some of the palms are already noble specimens, and not a few rare kinds among them. A large species of *Strelitzia*, resembling *Strelitzia augusta*, but said to be different from it, I had not previously seen. It is there called *Strelitzia Nicolai*, and came from the Botanic Garden at St. Petersburgh to the Berlin garden. Another remarkable plant was a large species of bamboo cane, *Bambusa latifolia* of *Kunth*. The leaves of this cane are nearly 6 inches wide, and the canes much stronger than those of the plant generally cultivated in British collections. The Agave tribe of Amaryllidaceous plants, which are so great favourites on the Continent, are well represented at Berlin, and some fine specimens among them. There is also a good collection of the globular-formed cacti, so well known from the figures published of many of these by Dr. Pfeiffer and the late Inspector Otto. The hardy trees are neither very numerous nor large, but I observed a good species of poplar among them, which I am not aware has yet been grown in Ireland. It is there called *Populus laurifolia*, and forms a tree 60 feet high, with large shining leaves.

The next garden I visited in the neighbourhood of the Prussian capital was that of M. Borsig, at Moabit, where there is a fine private collection of plants, the grand feature there being the amazing number of tropical aquatic plants cultivated in the open air. This is effected by supplying a winding stream, which passes through the garden, with a constant flow of hot water from the adjoining iron works. This stream is about 100 yards long by 20 wide, and is filled with them. The gardener, M. Goerds, informed me that only three years ago a single plant of *Nelumbinum speciosum* was planted, which has already

spread itself over a great portion of the stream; and on the day I visited, there could not have been fewer than one hundred expanded blooms of this loveliest of flowers. At the same time there were many flowers of *Victoria regia*, *Nymphæa Devoniana*, *Nymphæa cærulea*, *Nymphæa dentata*, &c., altogether producing such a charming floral picture as can hardly be imagined. Near the aquatics stood another interesting group of tender coniferous plants, among which were *Araucaria excelsa*, *Araucaria Cunninghami*, *Dacrydium Cupressinum*, some species of Dammara, &c. They were planted out in the open ground, and are covered in winter with a moveable conservatory. Their appearance in that state was so unlike that they have when starved in small pots or tubs, as scarcely to be longer recognisable as the same kinds of plants. In the extensive range of conservatories were some good specimens of palms, tree ferns, and orchids, most of which presented the appearance of rude health.

From Berlin I went to Potsdam, to see the terraced gardens, &c., at Sans-souci, which are a curiosity in their way. There are seven tiers of terraces rising one above the other, each of which is faced by a brick wall, which walls are occasionally covered with glazed sashes, according as the crops of figs, grapes, peaches, &c., require protection. A number of large and among them curious forms of gourds were lying on the walks, attached to the vines, which were planted on the borders, and allowed to trail over some parts of the walks, producing a pleasing effect on the terraces.

In Germany fine foliage appears to be more prized than mere showy flowers, in which respect the art of flower gardening differs materially there from the manner it is practised in England. At Sans-souci, the beds on the grass were filled with such plants as the dwarf fan palm, *Chamærops humilis*, *Caladiums*, and *Cannas* of sorts; and even our common rhubarb found a place among the number, and played no mean part as an ornamental plant. In other beds the large grass *Arundo donax*, with varieties of Indian-corn plants, formed good contrasts to those which were occupied with Pelargoniums, &c. To the eye of an English gardener, who cultivates twenty kinds of scarlet Pelargoniums, each differing slightly in colour of flower and in foliage, with twice that number of shades of colour among his beds of verbenas, such plants as I have stated will no doubt appear coarse and incongruous; but let the two methods be placed before the eye of a good landscape painter, I can readily opine which he will choose.

The new orangery, which is I dare say by the time I write finished, is on a surpassing scale of magnitude. It is 1000 feet long, by 45 wide and 25 high. In general appearance, it seems a massive heavy building, with pillars of cut stone along the front, between the upright sashes; and at the back part there is a sort of gallery, raised about 8 feet above the level of the floor. I believe it is intended for a winter promenade for the officers of the household, &c., as well as for sheltering plants. In front, new terraced flower gardens have been com-

menced, which will ultimately have a magnificent effect, if carried out on a scale commensurate with the great conservatory.

Near Sans-souci is the extensive nursery collection of M. Fricke, at Augustin, where, I believe, the largest quantity of palms are cultivated for sale which is to be found in any single establishment in Europe at the present time. One large range of conservatories, about 400 feet long, was mostly filled with palms and ferns, and other smaller houses with many very rare plants. This collection seemed to me to bear a greater resemblance to that which the Messrs. Loddiges, at Hackney, had twenty years ago, than any other I have seen, and the prices asked were very reasonable. A large plant of *Dasylirion acrotriche* was then in flower, this being the first time I had seen this species blooming.

From Prussia I went to Hanover by rail, which enabled me to get a railway view of the agricultural crops along the line. The country from Berlin to Magdeburgh appeared to be mostly of a light sandy nature, and in many instances had a barren look; but the numerous fields of *Lupinus succulentus* in full bloom produced there, as elsewhere, a warm and pretty effect. After Magdeburgh is passed, the country improves in fertility and cultivation until Brunswick is reached, in the neighbourhood of which I observed large fields of mangel, carrots, rape, and gold of pleasure, *Camelina sativa*, ripening into seed, this being a part of Germany where those crops are largely cultivated for supplying the seed market. Soon after arriving in Hanover, I visited the fine old botanical garden at Herrenhausen, where I was speedily joined by the Director, M. Wendland, to whom I carried a letter of introduction from a friend in England.

The grand feature of this garden is the great collection of palms, for which it has long been famous; it is also rich in species of Pandaneæ and Cycadeæ. The principal palm-house is said to be 120 feet long, by 40 high, and 30 wide. The most remarkable plant in it is a magnificent specimen of *Corypha australis*, which has a clean stem for 14 feet, measuring 6 feet in circumference at the base, and had on it, at the time I saw it, 114 full-grown leaves. There were also good plants of *Manicaria Saccifera*, *Geonoma electropus*, *Areca aurea*, *Areca Verchaffelti*, *Iricartea gigantea*, *Morenia gigantea*, *Frecynetia insignis*, *Frecynetia rubra*, *Pandanus latissimus*, *Pandanus sessilis*, *Macrozamia eriolepis*, *Macrozamia Skinneri*, *Lechtenbergia princeps*, &c., &c., some of which I expect to get in return for plants I sent to M. Wendland last autumn. A rather extensive flower-garden in front of the Royal Palace has lately been laid out in the French style, which I had not time to look minutely through; but my attention was arrested on seeing a large tree of *Sophora japonica* in full bloom, which does not flower in Ireland that I am aware of, though it grows so freely. The fine avenue leading from the town of Hanover to the Botanic Garden is straight from one end to the other, and between one and two English miles in length. On each side are several lines of old lime trees, planted at equal distances, which extend the whole of the way, thus affording shade and shelter to the inhabitants, who so much frequent the avenue and park. The journey from

Hanover to Amsterdam was performed by night train, which prevented my seeing much of the agricultural crops until Oberhausen was reached. From thence on to Utrecht, the country through which the line of railway passes, presents a rather wild and barren aspect, and although nearly level, is considered the highlands of Holland. Extensive tracts of sandy heath land, covered in some places with dense woods of Scotch fir, with canals and ditches standing full of water, appear to be characteristic features of that portion of country. From Utrecht until Amsterdam is reached, is nearly one vast level plain, intersected by canals, with extensive grazing fields, covered with herds of black cattle, having a few white patches on each, but so like in colour, that one scarcely differs from the other.

The Botanic Garden at Amsterdam is small, but contains a number of good plants, and is especially rich in cycadeæ. M. Groenewegan, the Inspector, kindly conducted me through the conservatories, and pointed out anything of special interest, among which were the following cycads:—*Cycas inermis* (female plant in fruit); *Cycas circinalis*, fine; *Cycas Rumphii* (female plant); *Cycas Altensteinii*, large; *Encephalartos caffra*, with clean stem 12 feet high; *Encephalartos Lehmanii*, fine; and *Encephalartos cycadifolia*, new, and fine. There were also some of the pretty variegated-leaved orchids not often found in collections, particularly *Pogonia discolor*, and *Goodyera colorata*. I also went to see M. Willink's collection, near Amsterdam, which is rich in tree ferns, and many of them fine specimens. *Dicksonia chrysotricha, Alsophila contaminans, Alsophila senilis, Alsophila subacaulis, Alsophila compta, Lophosora affinis, Ciboticum Cummingi, Angiopteris hypoleuca, Marattia Willinki*, and *Hermionitis Blumeii*, were all in large-sized plants. From this point I visited the far-famed Bulb gardens, at Haarlem, and there spent a day among them. Previous to this, I had not formed a correct idea of the soil on which our beautiful Hyacinth roots, Tulips, Polyanthus, Narcissus, Gladioli, &c., &c., are so extensively produced. It is almost pure sand, with a slight mixture of the debris of alluvial clay. Our Dublin Hyacinth-growers might form a very good notion of the position those gardens occupy, by supposing the little town of Baldoyle, near Howth, to be Haarlem, with Portmarnock sand-hills between it and the sea, preventing the farther encroachment of the waves, and the small farms inside the sand-hills the Bulb Gardens. Under this supposition, the localities are similar; but here we want the greater heat in summer, besides another important desideratum which we cannot supply, namely, plenty of moisture at a short depth from the surface during the dry season, when the plants are growing vigorously, and forming their bulbs. At Haarlem the ground is intersected by canals and deep ditches at every 100 yards or so, from which the water percolates at its level, and supplies the plants with plenty of moisture at the period of their growth when it is specially required. With this soil large quantities of cow manure is mixed, on which the bulbs are planted; but I could not learn that any other particular manipulation was resorted to, further than to keep the ground clear of weeds.

We can form very little idea respecting the extensive scale those plants are cultivated on, until we have actually seen it. Large squares of Polyanthus, Narcissus, and Crocuses had already been planted in September, when immense quantities of Hybrid Gladioli were in bloom. The Messrs. Rosenkrantz kindly conducted me through their drying and saving houses, where the remaining portion of their bulbs were spread out on airy shelves; but the greater part of them had been despatched before that time to the English and Russian markets, where the principal consumption takes place. Haarlem is on the same line of rail to Leyden, where I went to see the old Botanic Garden, so famous in early European botanical history, in connexion with the names of Linnæus, Clusius, and other eminent botanists during the past and present centuries. On a tablet there is the following quaint epitaph to Clusius:—

"*Non potuit pluris quarere, Clusius herbas ergo novas campis quaerit in Elysis.*"

A few of the old trees planted by Linnæus were pointed out by the present Inspector, M. Witté, who kindly accompanied me. The garden is yet well kept up, and contains a fair collection of botanical plants, both tender and hardy, some of which are rare species. In the Orchid-house I observed plants of *Phalænopsis zebrina*, *Cyprepedium caudatum*, *Cyprepedium hirsutissimum*, *Lycopodium phlegmaria*, and *Lycopodium furcatum*. Among the hardy trees outside, there is the largest one of *Salisburia adiantifolia* I had previously seen, which must have been among the earliest planted of its kind in Europe. It is now almost 60 feet high, with a stem 6 feet in girth. There are also large specimens of *Gleditchia horrida*, and *Catalpa Kæmpferi*. The herbaceous plants are arranged according to Endlicher's system, and appeared to comprise a good collection. The Hague and Rotterdam were next visited, but I could not learn there was much of particular interest in the way of botanical or horticultural gardens near them. I therefore devoted all the time I had to spare in visiting the principal picture galleries, and zoological garden at Rotterdam; when, after looking through those curious old towns, I passed on to Antwerp.

Having previously made some acquaintance with M. Charles Van Geert, I went first to see his nursery, which is well worthy of a visit from lovers of ornamental plants. Selections of most of the trees and shrubs which stand hardy in Europe are to be found in this nursery, as well as fair collections of hardy green-house, and herbaceous plants. Among them, I noticed good plants of *Acer palmatifida*, *Acer pseudo-platanus purpurea*, *Robinia inermis pyrimadalis*, *Pavia Californica*, *Quercus nigra*, *Quercus macrocarpa*, *Juglans lacerata*, *Castanea dissecta*, *Tilia Mississippiensis*, *Ulmus Dampieri*, *Cornus mascula variegata*, *Populus pendula variegata*, &c., &c.

In the neighbourhood of this nursery is the residence of Madam le Grele, who possesses an extensive private collection of good plants; but what I wished particularly to see there was the large specimen of *Theophrasta imperialis*, which is certainly a magnificent plant. Its dimensions are in height about 12 feet, in diameter about 6 feet, and well covered with healthy foliage, each leaf from 2 to 3 feet long.

My next stage was Ghent, where I visited the fine nurseries of M. Van Houte, M. Verchaffelt, and M. A. Van Geert, all of which are well known to most plant-growers in England and Ireland through their advertisements and catalogues, which are annually issued, as well as from personal visits. Having noticed them in detail on a previous occasion, I need not allude to them more particularly at present, further than to say, I deem it a treat of no ordinary kind to be allowed to inspect those splendid collections of plants, especially when accompanied by the polite and highly intelligent proprietors of them. Leaving Ghent, I reached England, *via* Ostend, after a most agreeable and profitable tour.

N. B.—The writer of the foregoing notes begs it may be fully understood that he does not in any way hold himself responsible for the names of the different plants mentioned being in all cases correct, or even such as they are at present known by in England. They were either taken from labels attached to the plants, or orally communicated by the gentlemen who accompanied him through the different establishments; and consequently have been adhered to, with a view of facilitating correspondence, as the plants are known at the different gardens and nurseries by the names he has given.

XIX.—On the Composition of Dublin Porter. By George W. Jackson, B. A., and William J. Wonfor, Students in the Laboratory of the Museum of Irish Industry.

[Read before the Royal Dublin Society, on Monday, December 17, 1860.]

A want has often been felt by medical men, and others, in Dublin, interested in the composition of such substances, of a reliable and complete analysis of Irish porter; for although the composition of the principal English and foreign beers has been determined by different chemists, no such investigation had hitherto been undertaken in Dublin. At the suggestion of Professor Galloway, Mr. Jackson undertook the analysis of Guinness's XX porter; but at an early stage of the proceedings being obliged by ill health to forego the completion of the research, the task devolved on me to finish it; and we have much pleasure in laying before the Royal Dublin Society the results of our joint investigation. The sample of porter which we employed was obtained from Mr. Edward Burke, of Middle Abbey-street, agent to the Messrs. Guinness; and the analysis was performed in the laboratory of the Museum of Irish Industry, under the direction of Mr. Galloway.

The different determinations were made in the following manner:—

1000 grs. by measure were evaporated to dryness in a water bath, and the residue then dried at a temp. of 212° F. until it ceased to lose weight: this gave the amount of solid matter. The ash was obtained

by burning the residue, which being deducted from the total quantity of solid matter, gave the amount of organic matter.

By a careful qualitative examination of the ash, silica, lime, phosphate of magnesia, potash, soda, hydrochloric, phosphoric, and sulphuric acids, were discovered.

The ash was treated with hydrochloric acid; the insoluble portion collected on a tared filter, dried at 212° F.; washed, and again dried, and weighed; this gave the quantity of charcoal and silica. The filter and insoluble matter were then incinerated, and the inorganic matter weighed, after deducting the weight of the filter ash, and subtracting the remainder from the total insoluble residue; this gave the amount of charcoal.

The filtrate, together with the wash water from the insoluble residue, were collected in a flask capable of holding 20,000 grains by measure of liquid, which was then made up to the mark with distilled water.

Two estimations were made of all the constituents, with the exception of the insoluble residue, in order to insure accuracy; 7000 grs. of the solution being employed.

Acetic acid was added to the solution, and the lime then precipitated by the addition of oxalate of ammonia, and estimated as carbonate in the usual manner.

The filtrate was concentrated by evaporation, and ammonia then added in excess, to precipitate the phosphate of magnesia, which was collected on a filter, washed with ammonia water, dried, ignited, and weighed.

The filtrate from the phosphate of magnesia was concentrated, and a clear mixture of solutions of chloride of ammonium, ammonia, and sulphate of magnesia added, and the whole allowed to stand for twelve hours in the cold; it was then filtered, the precipitate washed with ammoniacal water, and weighed as pyrophosphate of magnesia, from which the amount of phosphoric acid was calculated.

The filtrate from the phosphoric acid precipitate was evaporated to dryness, and ignited, in order to expel ammoniacal salts; the residue was dissolved in water, baryta water added to the solution, and the precipitate which contained the magnesia and sulphuric acid was collected on a filter, and washed; carbonate of ammonia was then added to the filtrate, to separate the excess of baryta, and the filtrate from the carbonate of baryta which contained the alkalies again evaporated to dryness, and ignited; the residue was dissolved in water, hydrochloric acid added; and the solution evaporated to dryness in a weighed crucible; the residue was ignited, and the mixed alkalies weighed as chlorides; the potash was then separated from the soda, by the addition of bichloride of platinum; the precipitate, being collected on a dry filter of known weight, was dried in an air bath at a temperature of 212° F., and estimated as potassio-bichloride of platinum.

3000 grains of the solution were employed for the estimation of the sulphuric acid; chloride of barium was added, and the precipitate collected on a filter, washed, ignited, and weighed as sulphate of baryta.

A portion of the ash was dissolved in pure nitric acid, and nitrate of silver added to the solution to precipitate the hydrochloric acid; the precipitate was washed by decantation, collected on a filter, dried, ignited, and weighed as chloride of silver.

For the determination of the nitrogen, 1000 grains by measure of the porter were evaporated to dryness, the nitrogen in the residue being converted into ammonia by combustion with soda lime; but, on account of the adhesiveness of the residue, it was found necessary to mix the porter with carbonate of lime before evaporation, care being taken that not the slightest trace of ammonia existed in the carbonate. The ammonia formed during the process was, in one estimation, collected in a solution of hydrochloric acid, and the quantity of acid which remained unneutralized was estimated as ammonia-bichloride of platinum—and in the other estimation it was collected in a standard solution of sulphuric acid, and estimated by a standard solution of ammonia. The nitrogen was calculated as albumen, on the assumption that 15·92 parts of nitrogen are equal to 100 parts of albumen.

The spirit was estimated in Phillips' distilling apparatus; 2000 grains by measure of the porter were employed and about two-thirds of the quantity distilled over, the distillate was made up to 1600 grains with distilled water, and the specific gravity taken by the sp. gr. bottle at the temperature of 60° Fahr.; from this was calculated the amount of spirit in 1000 parts.

To the residue which remained in the flask after the distillation of the spirit, was added, when cold, 150 grs. of yeast, and the mixture kept at a temperature of about 80° Fahr. for about twenty-four hours, care being taken to connect the flask in which the fermentation was carried on with the condenser, so that any alcoholic vapour which might be exhaled during the fermentation should not be lost; when the fermentation had entirely ceased, heat was applied to the flask to distil off the alcohol, about two-thirds of the liquor was distilled over, and the distillate collected in a cooled receiver, and made up to 1600 grs., the specific gravity was then taken by the sp. gr. bottle. To obtain a correction for the small quantity of alcohol introduced by the yeast, a parallel experiment was made with that substance; the same weight of yeast was mixed with water, and distilled in a similar flask; the distillate was made up to the same volume as the preceding, and the specific gravity taken. The quantity of absolute alcohol by weight in the two liquids was calculated from the specific gravities, and the amount in the yeast deducted from the total amount: this gave the quantity of alcohol due to the porter, and from this the quantity of grape sugar was calculated.

The sugar and albumen were then deducted from the total amount of organic matter, and the difference gave the amount of extractive matter.

The acetic acid was estimated by adding to 2000 grs. of the porter a standard solution of ammonia until all the free acid was neutralized.

First Analysis.

SPECIFIC GRAVITY OF THE PORTER, 1019·565.

Estimation of the alcohol:—

2000 grs. by measure of the porter gave,—
1600 grs. of a spirit having a sp. gravity of 991·2 at 60° Fahr.
= 179·2 grs. of proof spirit in the 2000 grs. of porter.
= 89·6 grs. of proof spirit in 1000 grs. by measure of porter.

Estimation of the sugar:—

The residue from the distillation of the spirit gave, after being fermented with

150 grs. of yeast, 1600 grs. of a spirit having a sp. gr. of 999·37 = 5·68 grs. by wt. of absolute alcohol in the 1600 grs. of spirit.

150 grs. of the yeast when distilled yielded 1600 grs. of a spirit having a sp. gr. of 999·59 = 4·08 grs. by weight of absolute alcohol in the 1600 grs. of spirit, 5·68 – 4·08 = 1·6 grs. by weight of absolute alcohol = 3·44 grs. of grape sugar (C_{12}, H_{11}, O_{11}, 3 HO) = 1·72 grs. of grape sugar in 1000 grs. of porter.

Estimation of acetic acid:—

2000 grs. by measure of the porter required,
120 grs. of a stand. solution of ammonia (1 eq. in 1000 grs.) = 7·2 grs. of acetic acid,
= 3·6 grs. of acetic acid (C_4 H_3 O_3, HO) in 1000 grs. of porter.

Estimation of albuminous compounds:—

1000 grs. by measure gave 1·317 grs. of nitrogen—
= 8·272 grs. of albumen.

Estimation of solid residue, organic and inorganic:—

1000 grs. by measure gave 71·732 grs. of solid residue, which yielded 4·166 grs. of inorganic matter (ash),
71·732 – 4·166 = 67·566 grs. of organic matter.

Estimation of chlorine:—

12·149 grs. of ash gave 3·208 grs. of AgCl.,
= 0 793 grs. of Cl. = ·272 grs. in 1000 grs. of porter.

Estimation of sulphuric acid:—

7·877 grs. of ash gave 1·529 of BaO, SO_3,
= 525 of SO_3 = ·277 in 1000 grs. of porter.

Estimation of silica:—

28·721 grs. of ash gave 2·047 of insoluble residue, which contained ·048 of charcoal, and 1·999 of silica; therefore 28·721 – ·048 = 28·673, the quantity of inorganic matter employed.

1·999 of silica in 28·673 of ash = ·290 in 1000 grs. of porter.

Estimation of lime :—

10·035 grs. of ash gave ·367 of CaO, CO_2.
= ·205 of CaO = ·085 in 1000 grs. of porter.

Estimation of phosphate of magnesia :—

10·035 grs. of ash gave 2·052 of $2MgO, PO_5$.
= ·851 grs. of phos. mag. in 1000 grs. of porter.

Estimation of phosphoric acid :—

10·035 grs. of ash gave 2·595 of $2MgO, PO_5$,
= 1·66 of PO_5 = ·690 in 1000 grs. porter.

Estimation of the alkalies :—

10·035 grs. of the ash gave 6·44 of the mixed chlorides ;
6·44 grs. of the mixed chlorides gave
19·04 grs. of $Pt\,Cl_2$, KCl = 5·82 of KCl.
6·44 - 5·82 = ·62 of $NaCl$.
5·82 of KCl = 3·677 of KO.
0·62 of $NaCl$ = ·33 NaO,
= 1·527 of potash in 1000 grs. of porter,
= 0·273 ,, soda in 1000 grs. of porter.

Second Analysis.

SPECIFIC GRAVITY OF THE PORTER, 1019.200.

Estimation of the alcohol :—

2000 grs. by measure of the porter gave
1600 grs. of a spirit having a sp. gr. of 990·967 at 60° Fahr.,
= 184 grs. of proof spirit in the 2000 grs. of porter,
= 92 grs. of proof spirit in 1000 grs. of porter.

Estimation of the sugar :—

The residue after the distillation of the spirit gave, after being fermented with 150 grs. of yeast,
1600 grs. of a spirit, having a sp. gr. of 999·37,
= 5·68 grs. by weight of absolute alcohol in the 1600 grs. of spirit.
150 grs. of the yeast when distilled yielded 1600 grs. of a spirit, having a sp. gr. of 999·59 = 4·08 grs. by weight of absolute alcohol in the 1600 grs. of spirit,
5·68 - 4·08 = 1·6 grs. by weight of absolute alcohol
= 3·44 grs. of grape sugar (C_{12}, H_{11}, O_{11}, 3 HO),
= 1·72 ,, ,, ,, in 1000 grs. of porter.

Estimation of acetic acid :—

2000 grs. by measure of the porter required
120 grs. of a standard solution of ammonia (1 eq. in 1000 grs.),
= 7·2 grs. of acetic acid (C_4, H_3, O_3, HO),
= 3·6 grs. of acetic acid in 1000 grs. of porter.

Estimation of albuminous compounds :—

1000 grs. by measure gave 1·2 grs. of nitrogen,
= 7·5 grs. of albumen,

Estimation of solid residue, organic and inorganic :—

1000 grs. by measure gave 70·696 grs. of solid residue, which yielded 4·27 grs. of inorganic matter (ash),
70·696 – 4·27 = 66·426 grs. of organic matter.

Estimation of chlorine :—

15·180 grs. of ash gave 4·037 grs. of AgCl.
= ·998 grs. of chlorine = ·274 grs. in 1000 grs. of porter.

Estimation of sulphuric acid :—

4·308 grs. of ash gave ·833 grs. of BaO, SO_3,
= ·286 grs. of SO_3 = ·274 in 1000 grs. of porter.

Estimation of Silica :—

28·721 grs. of ash gave 2·047 of insoluble residue, which contained ·048 of charcoal and 1·999 of silica, therefore 28·721 – ·048 = 28·673, the quantity of inorganic matter employed.
1·999 of silica in 28·673 of ash = ·290 in 1000 grs. of porter.

Estimation of lime :—

10·035 grs. of ash gave ·367 of CaO, CO_2.
= ·205 grs. of Ca O = ·085 in 1000 grs. of porter.

Estimation of phosphate of magnesia :—

10·035 grs. of ash gave 2·063 of 2MgO, PO_5,
= · 856 grs. of phosphate of magnesia in 1000 grs. of porter.

Estimation of phosphoric acid :—

10·035 grs. of ash gave 2·649 of 2MgO, PO_5,
= 1·694 of PO_5 = ·703 in 1000 grs. of porter.

Estimation of the alkalies :—

10·035 grs. of the ash gave 6·394 of the mixed chlorides,
6·394 of the mixed chlorides gave
18·975 grs. of Pt Cl_2, KCl = 5·73 of KCl,
6·394 – 5·73 = ·664 of NaCl,
5·73 of KCl = 3·62 of KO,
·664 of NaCl = ·35 of NaO,
= 1·50 grs. of potash in 1000 grs. porter,
= ·275 grs. of soda in 1000 grs. porter.

The following are the amounts of the various constituents in 1000 parts by measure of the Porter:—

	I.	II.	Mean.
Total Amount of fixed Organic Matter, .	67·566	66·426	66·996
Total Amount of fixed Inorganic Matter,	4·166	4 270	4·218
	71·782	70·696	71·214
Proof Spirit,*	89·6	92·0	90·8
Acetic Acid, ...	8·6	8·6	8·6
Grape Sugar, ...	1·72	1·72	1·72
Albumen, ...	8·272	7·50	7·886
Extractive Matter, ...	57·574	57·206	57·390
Silica, ...	·290	·290	·290
Phosphoric Acid, ·544; Magnesia, . . ·307; —— ·851 } Phosphate of Magnesia, .	·851	·851	·851
Lime, ...	·085	·085	·085
Phosphoric Acid, ...	·690	·708	·697
Chloride of Sodium, ...	·448	·449	·448
Sulphuric Acid, ...	·277	·274	·276
Potash, ...	1·527	1·500	1·518
Soda, ...	·082	·083	.082
	71·816	70·661	71.238

In One Gallon by Measure,

Total amount of fixed organic matter, ...		4689.70
Total amount of fixed inorganic matter, . .		297.64
		4987.34
Alcohol (proof spirit), ...		6356.00
Acetic acid, ...		252.00
Sugar, ...	120.50	
Albumen, ...	552.00	
Extractive matter, ...	4017.30	
Silica, ...	20.30	
Phosphate of magnesia, ...	59.71	
Phosphate of lime, ...	11.06	
Phosphoric acid, ...	44.31	
Sulphate of potash, ...	42.00	
Potash, ...	83.16	
Chloride of sodium, ...	31.36	
Soda, ...	5.74	
	4987.44	

* Proof spirit has a sp. gr. of 0·9198 at 60° Fahr. and contains 49¼ per cent. by weight of real alcohol.

In stating the proportion of the inorganic constituents, we have combined in the gallon the magnesia and lime with phosphoric acid, the chlorine with sodium, and the sulphuric acid with potash; leaving part of the potash, part of the soda, and part of the phosphoric acid, uncombined. Our reason for this was, that when we combined them together, we found an excess of the bases over what was requisite to form with the phosphoric acid salts having the formula of $2MO, PO_5$; and an excess of phosphoric acid, if we gave the salts the formula of $3MO, PO_5$.

Without expressing any opinion as to the medicinal virtues of the porter we examined, we may, perhaps, be permitted to draw attention to the facts which our analysis reveals, that it contains a large quantity of heat and flesh-producing matter, as well as the necessary inorganic constituents required in the formation of bone and flesh.

As we were obliged to limit ourselves to one sample of porter, as it would have required more time than we could give to have examined samples of porter from all the different manufactories, we selected Guinness's as the type of all the rest.

XX.—On the Generative System of Helix Aspersa and Hortensis. By Henry Lawson, M.D.

(Plate VIII.)

[Read before the Natural History Society of Dublin, Friday, December 7, 1860.]

The following observations upon the reproductive system of *Helix aspersa*, our commonest Irish snail, are given as the result of a series of dissections and microscopic examinations, made during the past summer. The object of the paper is twofold—firstly, to supply a deficiency in our text-books on zoology and comparative physiology, by publishing the descriptive anatomy of the species of *Helix* most widely distributed in Ireland, and of thus affording to the student of natural history an opportunity of verifying by dissection the descriptions given—a circumstance too much neglected by writers upon the subject, who prefer the less difficult task of quoting, wholesale, the investigations of Cuvier, which were made upon that species (*Helix pomatia*) most abundant in his own neighbourhood. Secondly, to put forward my own opinion concerning the relations of function of the parts which compose this system.

The generative organs of this animal are hermaphrodite in their nature, and excessively complicated in their arrangement. They occupy a larger volume of the body comparatively with the other systems than at first one would be inclined to suppose, extending from one extremity to the other, and seeming more or less closely related to every organ in the economy of the creature. They present an external aperture adjacent to the right upper tentacle, and terminate at the ovary, in the final spire of the shell. For convenience, they may be divided into four groups :—

1. Female.
2. Male.
3. Androgynous.
4. Appendicular.

Of these, the female organs form by far the largest portion, and extend over the greatest surface. They consist of an ovary, oviduct, albumen-gland, and uterus. The ovary is a small, rather compact, fan-shaped gland, spread over the last lobe of the liver, and, with it, included in the terminal volution of the shell; its broad, or basal extremity, is most external, the narrow portion being directed inwards, to terminate in the commencement of the oviduct. When separated from its attachments, it measures at its widest part about three-eighths of an inch; whilst from within outwards, it is about a quarter of an inch. It is composed of numerous branching cœca, or lobules, of a light-yellowish colour, bound together by folds of a delicate areolar, or fibrous membrane. A portion placed under the microscope presents the appearance of a follicle, secreting from its inner wall numerous oval, or spherical, nucleated cells, and having occasionally within it, and rather near its mouth, a few isolated zoosperms—no trace whatever of a second sac invaginated by the former can be observed. The ducts of the various lobules unite toward the apex of the organ, and form a common channel—the oviduct. This vessel bends its course in a spiral direction, from the ovary to the albumen-gland. It is simple at both extremities, but very much convoluted in the interval. It is about seven-eighths of an inch in length; and before it terminates in the sinus of the albumen-gland, it makes a slight spur-like turn backwards. (I have not seen any of those decided projections on its convoluted portion, which Professor Goodsir has described as existing in *Lymneus involutus*.) Examined microscopically, nothing resembling a second tube included within the duct is to be seen. The albumen-gland is a large, homogeneous-looking structure, in shape like a boat, situated in the first spire of the shell, of which it occupies one-half. It lies beneath the lung, rectum, heart, and urine-gland. Its concave surface embraces the second spire, whilst its keel is bounded externally by the liver, into which its apex or prow also projects, its base or stern being attached to the upper extremity of the uterus. It measures about an inch in length, and is composed apparently of two distinct portions, an opaque and a translucent. It is very difficult, if not impossible, to ascertain its minute structure. A central duct traverses its substance, which would seem to collect from others more minute the peculiar gelatinous secretion. Viewed under the microscope, a confused chaos of spherical albumen-globules and minute fibres is observed. I have not found any zoosperms in this organ. The sinus is a membranous expansion, formed at the point of junction of this gland with the uterus; into it the oviduct passes, after having been lodged for some short distance in the substance of the albumen-gland. The uterus is a sacculated duct, measuring usually an inch and a half in length, and being fully one-eighth of an inch in

calibre. Starting from the last-named gland, it makes two or three zig-zag turns, and ends as a cylindrical vessel in the vagina. It is closely adherent along its whole length, to the testis which lies on its left border, and which, being shorter than the uterus itself would be if isolated, has the effect of producing the various sacculi above described; so that the two together have not been inaptly compared to the intestine supported by its mesentery. It is situated upon the powerful muscles of the foot, and has the gullet and salivary-glands on its left. At the period of depositing the eggs, this vessel becomes enormously distended, the sacs appearing much more distinct than usual, each containing its large ovum, and separated from its neighbour by a well-marked constriction. I am inclined to agree with Turpin, in believing that the uterus secretes those beautiful rhombic crystals of carbonate of lime seen on the egg of this animal, inasmuch as I have not found them upon those ova which had just entered the upper sacculi, whilst those situate in the lower ones were invariably studded with them.

The male organs lie to the left of the female, and include the testis, vas deferens, and penis, with its flagellum. The first, as before mentioned, is closely united to the uterus, commencing and terminating with it; nevertheless, it is a very distinct and extensive structure, and deserves far more attention than has been heretofore bestowed upon it. It consists of a central duct, closed at its posterior extremity (as shown by the obstruction to liquids introduced as injections), which is beset on its sides by two rows of long white granular-looking follicles. These are observed, under the microscope, to open into the central channel, and to contain those oval and elliptical epithelial-like cells, usually described as the parents of zoosperms. The central vessel now leaves the testis, at the point of union of the uterus and vagina, and is continued as a simple duct for a distance of an inch and a half, or thereabouts, when it terminates by a rounded aperture in the penis. It is this portion to which the term vas deferens has been applied. The penis is represented by a long attenuated tube, wide, and of rather thickish consistence at its base, which is perforated, and communicates with the generative outlet, cœcal at its apex, which is extremely delicate, and situate deeply in the mass of viscera. It communicates with the vas deferens by a small aperture, distant from the basal opening about an inch and three-eighths, and measures, from end to end, when extended, about three inches and a quarter. The blind extremity, from its fancied resemblance to a whip-lash, has been termed the flagelliform portion. About the junction with the vas deferens, there exists, attached to the penis, a strong muscular fasciculus, which probably performs the function of drawing back this organ after it has been everted in copulation.

The androgynous group includes the vagina, vas deferens, and spermsac, with its duct and cœcum.

The vagina is usually described as the termination of the uterine portion; but from the direct continuation which it forms with the copu-

lative vessels, and its almost rectangular connexion with the uterus, it seems more correct to look upon it as the dilated extremity of the former. Viewing it thus, both may be said to constitute a tube, leading from the dart-sac, on the one hand, to the sperm-sac, on the other, wider at its proximal than at its distal end, about one inch and three-eighths in length, and one-sixteenth of an inch in diameter, following a backward course, beneath the superficial viscera, toward the anterior margin of the liver, where it expands abruptly into a spherical or pyriform bag—the spermatheca, or sperm-sac. This vesicle, whose office appears to be the storing up of the semen received during coition, varies in its dimensions under different conditions. Thus, immediately after union of the sexes, when distended by its seminal contents, I have often found it attain the size of a large swan-drop, being more than a quarter of an inch in diameter; whilst in specimens examined some time after the performance of the sexual function, it has rarely exceeded the bulk of a grain of sparrow-shot. I have had many opportunities of observing the nature of the contained zoosperms, yet I have never succeeded in seeing them isolated—they were invariably in enclosed bundles, or spermatophora. The cœcum is an appendage whose function, so far as I am aware, has not yet been investigated. It is a duct, springing from the copulative tube, at about a quarter of an inch from its union with the uterus. It measures three inches in length, is of slightly greater calibre than the tube, and terminates, by a blind extremity, at the point of junction of the uterus and albumen-gland. It is closely attached to the sinus before described, and, to a superficial observer, would seem to convey thus the male element to the female. It seems homologous with the duct connecting the sperm-sac and ovary in *doris* and *eolis*, which Messrs. Alder and Handcock have described in their anatomy of the Nudibranchs.

The appendicular group comprises the dart-sac, dart, and multifid vesicles. The dart-sac is a pyriform vesicle, bearing in miniature a decided resemblance to the human uterus; it is situated at the anterior extremity of the animal, to the right of the testes and penis, and is quite superficial, being covered only by the outer integument and loose fibrous tissue which involve the other organs. It is about half an inch in length, and in diameter a little above a quarter at its bore or fundus, and is provided with very dense and apparently muscular walls, which are pierced on the left, close to the external opening, by the termination of the vagina; it communicates with the generative cloaca by a small circular outlet, which is guarded by two delicately constructed lips. These may be traced from their point of union on the right side of the orifice, passing round and approximating on the left, where they leave a small portion unprotected. I would be cautious in hazarding an opinion upon their function, but it seems to me not unlikely that they may direct the penis in entering the vagina, and so prevent the possibility of its being lacerated by any existing remnant of the dart; while, on the other hand, by opening in a valve-like manner externally, they thus offer no obstruction to the exsertion of the

latter. Springing from the fundus of the sac is observed a fleshy conical projection, armed at its free end with a calcareous spicule—the dart or stilette. This projection, or papilla, is about one-eighth of an inch in length, and is distinctly tubular, being connected at the base with a small follicle, situated between the layers of the dart-sac. The stilette appears to be the secretion of this papilla; it is perfectly transparent, about a quarter of an inch long, tapering from base to apex, it is tetrahedral in form, the sides being trenchant; a transverse section appears like a square, upon each of whose external sides an equilateral triangle had been constructed; it is perforated throughout, and at its papillary extremity is funnel-shaped, the lips also being slightly everted, or trumpet-like. Thus it would seem to have the power of conveying the product of secretion of the follicle (if any) through the dart, and in this way by inoculation of inflicting the "love-inspiring wound." I believe it has been asserted on all hands that the stilette never penetrates beyond the integument of the animal against which it is projected; that such an assertion is correct I must with all deference deny, as I have in several instances observed it lying deeply imbedded among the viscera, whilst a second, quite distinct, existed in its normal position within the sac; nay more, from one specimen, which I examined at the period of depositing the eggs, I succeeded in extracting two almost perfect darts.

The multifid vesicles are a number of branching cœca, produced by the dichotomous division and subdivision of two small ducts, whose orifices are situate upon each side of the vagina, adjacent to its union with the dart-sac. In all there are about forty cœca, and each group extends for about half an inch in the lateral direction. As yet no distinct function has been assigned to them.

The cloaca is the canal which leads from without to the two great orifices of the genital organs within; it is of all, the most anterior; it is a very flexible vessel, about a quarter of an inch in length, and one-eighth in calibre; it terminates externally in a vertical slit, closed during life by a sphincter of elastic membrane. This, which is sometimes termed the generative outlet, lies at the distance of a quarter of an inch from the upper tentacle, on the right side, in a plane posterior, and a little inferior. Near this outlet is the communication with the penis, whilst at the further extreme of the cloaca is observed the orifice of the dart-sac before-mentioned.

It will be seen by the foregoing remarks that I have taken a view of the parts composing the generative system different from that heretofore put forward on the matter. The older supposition was, that the liver-imbedded gland represented the ovary, whilst the tongue or boat-shaped structure performed the part of testes;* more recently it has

* This was Cuvier's idea, and also that of J. F. Meckel, Carus, Erdl, Sister, Bendach, Pappenheim, Berthelen, Fyfe, and Rymer Jones. Van Beneden also held it; but he considered that gland a prostate, which is here maintained, to be in the sperm-secreting organ.

been conceived by Henrich Meckel, Siebold, Gegenbaur, and Moquin-Tandon, that the so-called ovary of the older writers is in reality an hermaphrodite gland, each lobule of which has contained within it a second, the external secreting ova, the internal zoospores, the oviduct also having a second vessel invaginated by it. Of these four, however, the two latter, who have been the latest to write upon the subject, deny that any included sac or duct exists. Moquin-Tandon, moreover, follows Van Beneden in his ideas concerning the prostate.

The following are some of the reasons which urged the adoption of the view I have now put forward.

Concerning the Ovary :—

A. Arguing merely from authorities, I feel inclined to agree with Cuvier and his disciples, inasmuch as his opponents, though men of great research and vast fame, are but few in number, and are equally divided in a matter of observation, upon which, in fact, their argument is wholly based.

B. I have carefully from time to time examined single lobules under the microscope with the aid of the compressor, and never have I succeeded in bringing any contained sacculi into view; although, when I placed several lobules in the compressor, I had an appearance produced somewhat resembling invagination, but evidently the result of some lobule becoming superimposed, and then pressed into the substance of another.

C. There being no invaginated duct leading from the ovary, the zoosperms, if there secreted, would have a greater tendency to pass into the normally widened uterus than into the constricted vas deferens (indeed, the latter passage could not be effected, as there is no communication of the vas deferens with the uterus), and so would pass away externally, and be lost; but such a state of things could not reasonably exist.

D. From my own observations I may make use of Mr. Handcock's most ingenious argument applied to the Nudibranchs, that, as the zoosperms were found in a condition of imperfect development in the sperm-sac, and fully matured and isolated in the lobules of the ovary, they could not have proceeded from the latter; for, had they been there secreted, they would have been observed in process of development in the ovary, and fully formed and unconnected in the spermatheca.

Respecting the Testis.

A. As there is but one gland in connexion with the vas deferens, and that so extensive as to rival the ovary in size and structure, we may fairly conclude that, if a testis exists at all, it is most probably its representative. It seems to me very unreasonable to term this gland, as Van Beneden has done, a *prostate;* such a mode of applying names to parts is more to be deprecated than the barbarous terminology of human anatomists, who not unfrequently call an interesting and peculiar struc-

ture *innominata*, when, to quote the language of a well-known author, "their little puddle of invention has been used dry." I cannot conceive what resemblance it is supposed to bear to an appendage found in another sub-kingdom, and whose function is so much unknown, that of two of the most distinguished physiologists of the day, one thinks it little more than a mass of muscles,—the other that, most probably, it is the part in the male homologous with, or representing, the uterus of the female.

B. The generative organs of the nudibranchiata, which have been so *exquisitely delineated* by Messrs. Alder and Handcock, bear on the whole so great an analogy to those of the pulmonifera, that it is very likely, as the sperm and germ producing organs are isolated in the former, so are they in the latter. The vas deferens in helix, with its continuation, the testis, which is attached to the border of the uterus, holds the place of the greatly elongate corresponding vessel in eolis, here being, however, less distinction or separation of parts.

EXPLANATION OF PLATE VIII.

A. The entire reproductive apparatus, natural size—*a*, albumen gland; *c*, cœcum; *d*, dart-sac; *o*, ovary; *ov*, oviduct; *p*, penis; *ou*, outlet; *v*, vagina; *vm*, multifid vesicles; *s*, sperm-sac; *sd*, spermatheca-duct; *t*, testis; *u*, uterus; *vd*, vas deferens.

B. Vertical section through the dart-sac, enlarged, representing the follicle, papilla, dart, protective valve, and orifice of vagina.

C. Outline view of the testis, greatly magnified.

D. A lobule of the ovary, enormously enlarged, exhibiting the absence of included lobule, and the isolated zoosperms at the aperture.

E. Transverse section through the stilette, exhibiting the trenchant outline and central perforation.

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XXI.—On the Occurrence of the Snowy Owl (*Nyctea nivea*) in the County Mayo. By Alfred Newton, M. A., Fellow of Magdalene College, Cambridge, F. L. S., &c.

[Read before the Natural History Society of Dublin, January 4, 1861.]

As the snowy owl is stated by the late Mr. William Thompson, in his admirable work on the "Birds of Ireland" (i. p. 95), to be "a very rare winter visitant" in that country, a record of the capture of one which I lately had the pleasure of seeing, may not be unacceptable to the Members of the Dublin Natural History Society. The bird I speak of was obtained at Ballycovey, in the County Mayo, on the estate of Mr. George Clive, Under-Secretary of State for the Home Department, and, as far as I could ascertain, somewhat late in the autumn of 1859. When first observed, it was sitting on a bog, and was approached without difficulty. The man who found it had no idea what it might be, and shot at it, wounding it slightly, but sufficiently to enable him to catch it alive. It soon recovered from the injury, and lived contentedly in a roomy cage until the beginning of October last, when, at my suggestion, Mr. Clive presented it to the Zoological Society of London, in whose gardens I saw it a week or two since, enjoying the society of a fellow-prisoner of its own species, which was obtained in Unst, the northernmost of the British islands, and which has been for many years in the Society's possession. I was told by the man who looked after Mr. Clive's bird, that it moulted its feathers towards the end of the summer; and it certainly was in beautiful plumage when I saw it at Ballycovey, the last week in September. I may perhaps be permitted to add that, as far as my own knowledge extends, we are without any certain information respecting the change or changes of plumage in this species, and I believe that any person who could furnish reliable facts bearing on the subject would be doing good service to ornithology.

XXII.—On the Occurrence of the Spoon-Bill in the County Cork. By R. P. Williams, M. R. I. A.

[Read before the Natural History Society of Dublin, February 1, 1861.]

In presenting to the Society these fine specimens of *Platalea leucorodia*, or white spoonbill, I am aware that I cannot add anything new to the accounts already published in the several works on ornithology; but it may, however, interest the Society to enter into some details as to the particular birds in question. For two of the specimens we are indebted to my relative, Richard Quin, Esq., of Firgrove, Innishannon, County Cork. The village of Innishannon stands on the left bank of "the pleasant Bandon, crowned with many a wood," which rises from the river to a considerable elevation, facing the rocky hill clothed with wood, which, on the opposite side, rises nearly perpendicularly. Along both sides of the Bandon, there are alluvial flats, which above Innishannon form rich pasturage for cattle in the bends of the river; at one of which, opposite Firgrove, Mr. Quinn (1846) shot the fine specimen of the Canada goose (*Anser Canadensis*), which is in the museum of the Society; below In-

nishannon, whether it be from want of improvement, or from being at a lower elevation, these flats extend to a considerable length and breadth, nearly to Kinsale, where the river enters the sea. In very high tides and floods they are partially submerged; about three miles down the river from Innishannon lies Shippool marsh, adjoining Shippool Castle, a very old seat of the Herrick family.

Early in December last year, while looking for snipe on the marsh, Mr. James Herrick fell in with a flock of four spoonbills, of which he shot one; of this I had immediate notice from Mr. Quin, for I had previously requested him to be on the look out for rare birds, the river near Kinsale being celebrated for the number of water-fowl and waders that frequent it. I wrote to him to endeavour to secure it, if it was really a spoonbill, and not the shoveller duck (*Anas clypeata*), which is often so-called; the result was, that Mr. Herrick most kindly presented it at once. For some days after, two were seen, and Mr. Quin was indefatigable in trying to secure them for me; but, owing to their wildness, it was very difficult to approach them. He, however, succeeded in shooting one (the specimen which I have had set up with expanded wings, to show the peculiar black shafts); the other he wounded; but on account of the extent of slob uncovered by the receding tide, it escaped, and has not since been heard of; it probably died, and was carried away by the winter's floods, which in the Bandon are very powerful on the fall of the tide, which rises to a considerable height, and pushes its waters as far as Innishannon Bridge.

About the same time, another was shot by Thomas Hungerford, Esq., of the Island, Clonakilty, County Cork, which he has also presented. These three birds were immature males, and, I presume, birds of the second year; what impresses me with this idea is, that I learn three other specimens have been sent to Mr. Glennon, of Suffolk-street, to be preserved, all of which were males; they were smaller, and not so white as the specimens before you; they are probably of the same age as the living specimens which may be seen at the Zoological Gardens.

On consulting Mr. Yarrell's work, and others relating to the spoonbills, it will be found that considerable differences are apparent between the immature and adult bird, the most remarkable of which is the crest or mane of elongated feathers of the occiput and neck in the adult birds. In the present specimens, there is but a very partial elongation; the colour of these is altogether white, except the shafts of the wing feathers; but in the adult a band of buff feathers covers the breast, extending upwards. The colour of the eye of the young birds is ashey-grey; in the adult it is orange-red; and probably the same takes place in the eyes of other birds that, when mature, are of a bright red or yellow, as in the case of the Egyptian goose, &c. We are told, also, there is a cere round the eyes to the base of the beak, which, in the immature birds, is covered with feathers.

Fortunately for information, these birds all fell into the hands of inquiring observers, by whom it was thought advisable to examine the contents of the stomachs, so as to find out on what these birds subsisted during a season the most inclement we have had for several years,

in spite of which the birds were in fine condition. In the works that I have been able to consult, the food is set down as small crustacea, molluscs, spawn of fishes, &c., but in none, except Morris, who says, "in addition, they eat grasses and the roots of plants," do I find any mention of what *all* these birds' stomachs contained, vegetable matter, probably some of the marsh grasses; no traces of crustacea or animal matter were found. Now, looking to the conformation of its beak, armed with a sharp broad nail at the end, I do not see why vegetable substances should not form a portion of their food, as in the case of the duck tribe, the palate and sides of whose beaks are not very dissimilar; and therein perhaps we may find a provision of nature by which the bird, in the absence of more favourite food, may adapt itself to altered circumstances; the breast-bones of these birds are produced before you; but I regret I am unable to exhibit the trachea, which are very remarkable, but, owing to some misunderstanding, they were not preserved. The fine plate in Yarrell's "British Birds," showing the peculiar figure of 8 contortion, will, however, supply the deficiency, and enable the Members to observe its peculiarity.

In the work of the late Mr. Thompson, we find records up to 1846 of those shot in Ireland; but I suspect others, as well as of many birds considered extremely rare, but not so, are, from the non-observant habits of our country gentlemen, altogether overlooked. I have heard that Dr. Harvey, of Cork, is aware of one shot in that county in 1859, and another at Westport; another was shot at the mouth of the Boyne, about the year 1854, by Reynolds, warrener to James Brabazon, Esq., of Mornington, but unfortunately not preserved, although lying for some time in the kitchen, and finally thrown out.

It would seem remarkable, that in the accounts published of the several captures, all the instances are on the sea-board, none in the inland counties, although extensive lakes and marshes abound, the resort of birds feeding similarly. The records of Thompson show that in 1808 one was shot in the Co. Antrim; two in Donegal in 1837 and 1838; one in the County Dublin, near Malahide (the specimen in the Society's collection), in November, 1841; one in the Co. Wicklow, in October, 1844; three in the Co. Wexford, in 1836, November, 1844, and in July, 1840; three in the Co. Waterford, in 1829, 1843, and 1845; two in the Co. Kerry, in 1832 and 1846: to the foregoing list, those shot in the Co. Cork are now added. The question why this should be I leave to those naturalists who have devoted their attention to the migration of birds. Were these birds on their southward flight to more genial climes? How is it to be accounted for that all were males? We learn that the spoonbills' nests only contain four eggs. Can the four alluded to have been all of the same nest—and the three others, sent to Mr. Glennon, have been also from one nest, as they appeared to be nearly identical in plumage? Or, do the sexes separate in the winter time, again to re-unite when the pairing season arrives?

I learn that when these birds were shot, the weather was mild; but previously there had been north-easterly gales, and they might have been returning from their breeding places in the North of Europe.

Some years ago, I had three of these birds alive, which were at first kept in a small enclosure, and subsequently enlarged on the ponds at Drumcondra Castle, which were wired around; they throve very well, wading along the edges, feeding on various substances, and with the waterfowl on a mixture of bran, potatoes, and oats; I do not recollect that anything else was supplied to them: after some time they escaped, but how I cannot tell; one thing I particularly remember, that it was very unpleasant to handle them, from the very disagreeable odour attached to them; and that they were covered with parasites, which ran about on the hands, if the birds were laid hold of. I shall now conclude by urging on the Members to exert themselves among their friends in the country, by which means many rare objects of natural history may be secured, and thus complete our museum of natural history.

XXIII.—Tables and Diagrams relative to the Rain-fall as observed in the Magnetic Observatory of Trinity College. By the Rev. Joseph A. Galbraith. (Plates IX., X.)

[Read before the Royal Irish Academy, Monday, February 25, 1861.]

Table I. gives the annual and monthly rain-falls for the last ten years, 1851–1860.

Table II. gives the monthly rain-falls of the ten years (1841–1850) as compared with those of the last ten years (1851–1860).

The numbers for the first ten years are taken from Dr. Lloyd's account of the Meteorology of Ireland, vol. xxii. of the Transactions of the Academy.

From this Table it appears that the mean rain-fall at Dublin for twenty years (1841–1860) = 29·02 inches.

Table III. gives the distribution of the rain-fall, according to the seasons, for ten years (1851–1860), from which the following mean values are obtained:—

Spring (March, April, May), ...	6·33
Summer (June, July, August), ...	7·81
Autumn (September, October, November), .	7·73
Winter (December, January, February), . .	6·76

In computing these mean values, the rain-falls for January and February, 1861, as taken from the day-book of the Observatory, were used as follows:—

January, ...	2·18
February, ...	3·67

It may be observed that the month of February, 1861, has been the wettest February for the last twenty-one years, the rain-fall being more than double the average amount.

Table IV. gives the number of dry days in each month for the last ten years (1851–1860). In this Table a day is counted dry if the rain-fall is less than a hundredth of an inch.

Average number of dry days in the year = 191·6
Average number of wet days in the year = 173·4

During the last ten years there have been only twenty-three days on which the rain-fall has exceeded one inch, and only thirty-three days on which it has exceeded seven-tenths of an inch. The heaviest rain-fall, amounting to 1·78 inch, occurred on the 1st of April, 1853: The two wettest consecutive days were 27th and 28th of September, 1856, on which 2·72 inches of rain fell; 1·31 inches on the 27th; and 1·41 inches on the 28th.

Plate IX. represents the rain-fall for twenty years, from 1841–1860; the ordinates which represent the depths of rain are drawn to a scale of one-tenth.

Plate X. represents Kirwan's observations on the rain-fall in Dublin, as observed at his house in Cavendish-row, from 1792–1808. These observations are to be found in volumes v., vi., vii., viii., and x. of the Transactions of the Academy. There seems to be no record of the year 1793.

The rain-gauge of the Magnetic Observatory is circular, having an orifice of 12 inches, and is placed on the flat roof of the Observatory, which is 17 feet above the level of the ground.

TABLE I.

Rain-fall for ten years, 1851–1860.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1851	5·28	0·49	2·38	1·77	1·31	2·71	3·48	2·01	1·81	3·27	1·01	0·88	26·40
1852	3·20	2·72	0·61	1·28	2·35	7·09	1·96	3·27	2·69	3·46	7·43	4·10	40·16
1853	2·75	2·16	1·63	3·81	1·04	1·91	2·73	1·93	2·39	4·32	1·69	2·60	28·96
1854	3·83	0·75	0·67	0·40	2·43	3·93	2·29	1·24	0·91	1·64	3·15	2·60	23·84
1855	1·24	2·83	1·50	0·59	1·74	1·92	3·68	2·74	1·84	4·83	1·41	1·65	25·47
1856	2·64	1·93	0·77	1·58	5·49	2·40	1·41	2·60	3·88	2·03	0·65	2·55	27·93
1857	2·66	1·80	3·18	3·96	1·48	3·28	1·65	1·20	1·57	2·65	1·79	0·44	25·11
1858	1·04	1·08	1·14	5·08	1·64	1·87	3·34	1·66	3·02	3·81	1·38	3·06	27·07
1859	1·43	1·00	2·59	3·99	0·68	1·24	1·35	1·92	3·01	1·62	3·24	3·21	25·28
1860	4·15	0·84	2·57	2·62	3·12	4·59	2·48	4·75	2·65	2·27	2·90	3·17	36·06
Mean	2·82	1·50	1·70	2·51	2·13	3·04	2·43	2·33	2·33	2·94	2·46	2·43	28·63

TABLE II.

Monthly rain-falls from 1841–1850, *compared with those from* 1851–1860.

Mean Value.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1841–1850	2·64	1·86	1·90	2·58	2·11	2·16	2·34	2·74	2·88	3·35	3·08	2·38	29·42
1851–1860	2·82	1·50	1·70	2·51	2·13	3·04	2·43	2·33	2·33	2·94	2·46	2·43	28·62
1841–1860	2·73	1·68	1·80	2·54	2·12	2·60	2·39	2·54	2·32	3·15	2·75	2·40	29·02

Mean rain-fall for twenty years (1841-1860) = 29·02 inches.

Table III.

Distribution of rain-fall according to the seasons.

Years.	Spring.	Summer.	Autumn.	Winter.
1851	5·46	8·19	6·09	6·80
1852	4·24	12·82	13·58	9·01
1853	6·48	6·57	8·40	7·18
1854	8·50	7·47	5·70	6·67
1855	8·83	8·84	7·58	6·22
1856	7·84	6·41	6·56	6·51
1857	8·57	6·13	6·01	2·51
1858	7·86	6·87	7·71	5·49
1859	7·26	4·51	7·87	8·20
1860	8·81	11·76	7·82	9·02
Mean,	6·83	7·81	7·73	6·76

Table IV.

Number of dry days in each month, with their average for ten years.

[N. B.—A day is counted dry if the rain-fall is less than the hundredth of an inch.]

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Dry days.	Wet days.
1851	8	19	10	17	18	16	16	9	24	16	17	21	191	174
1852	13	18	26	25	18	8	21	14	16	15	11	8	188	177
1853	12	12	15	23	20	17	18	28	19	11	15	14	184	181
1854	7	11	33	23	16	15	16	16	21	14	11	11	184	181
1855	16	9	18	22	16	14	16	14	20	18	21	16	195	170
1856	7	13	25	16	15	15	17	16	11	20	25	18	198	167
1857	14	16	14	7	22	19	15	19	15	16	21	20	198	167
1858	21	20	20	14	17	21	16	20	16	16	21	11	213	152
1859	20	13	13	14	26	22	21	16	11	17	18	18	204	161
1860	7	18	9	16	12	8	20	9	18	14	16	14	161	204
Aver. no. of dry days.	12·5	14·4	17·3	16·7	18·0	15·5	17·1	15·6	17·1	15·2	17·1	15·1	191·6	
Aver. no. of wet days.	18·5	13·6	13·7	13·3	13·0	14·5	13·9	15·4	12·9	15·8	12·9	15·9		173·4

XXIV.—On Clairaut's Theorem. By Professor Hennessy, F. R. S.

[Read before the Royal Irish Academy, February 25, 1861.]

Laplace has shown that this theorem follows whatever may be the density of the interior parts of the earth, provided it consists of similar concentric strata, and that the form of the outer stratum is ellipsoidal. In the "Philosophical Transactions" for 1826, Mr. Airy (the present Astronomer Royal of England) has presented an equivalent result; more recently, Professor Stokes has shown that we can deduce the law of variation of terrestrial gravity without any hypothesis whatsoever as to the earth's interior structure. He assumes merely that its surface is spheroidal, and that the equation of fluid equilibrium holds good at that surface. In vol. vi. of the "Cambridge Mathematical Journal," Professor Haughton presented a demonstration, founded upon the same assumptions as those of Professor Stokes, and in which he uses certain propositions relative to attractions which had been enunciated by Gauss and Mac Cullagh. While studying thela bours of those mathematicians, it appeared to me that the question could be entirely divested of the hydrostatical character, and that Clairaut's theorem may be directly deduced from the equations to the normal of any closed surface, without any considerations as to the physical condition of the matter forming that surface. Thus every surface concentric with the earth, and perpendicular to gravity, will possess the property of exhibiting this relation in the intensity of gravity at its various points.

Let X, Y, Z represent the components parallel to the rectangular axes of the forces by which a point is retained at rest on a given surface whose equation is $L = 0$. Then from the equations of the normal we have

$$Y\frac{dL}{dx} - X\frac{dL}{dy} = 0, \quad Z\frac{dL}{dx} - X\frac{dL}{dz} = 0,$$

when the resultant of these forces is perpendicular to the given surface. If we represent by V the potential of the earth on the particle in question, by w the angular velocity of rotation, we have

$$X = \frac{dV}{dx} + w^2x, \quad Y = \frac{dV}{dy} + w^2y, \quad Z = \frac{dV}{dx},$$

and the above equations become

$$\frac{dV}{dy}\frac{dL}{dx} - \frac{dV}{dx}\frac{dL}{dy} = w^2\left(x\frac{dL}{dy} - y\frac{dL}{dx}\right)$$

$$\frac{dV}{dz}\frac{dL}{dx} - \frac{dV}{dx}\frac{dL}{dz} = w^2\,x\,\frac{dL}{dz}.$$

If, in conformity with General Schubert's* recent determinations, we assume the earth's surface to be that of an ellipsoid, with three unequal axes, we should substitute for L

* Mémoires de l'Académie Imperiale des Sciences de St. Petersbourge, VII[e] serie, tome i.

$$\frac{x^2}{a^2} + b^4 + \frac{z^2}{c^2} - 1 = 0,$$

or
$$\frac{dL}{dx} = \frac{2x}{a^2}, \quad \frac{dL}{dy} = \frac{2y}{b^2}, \quad \frac{dL}{dz} = \frac{2z}{c^2};$$

whence we have

$$b^2x\frac{dV}{dy} - a^2y\frac{dV}{dx} = w^2xy\,(a^2 - b^2), \quad c^2x\frac{dV}{dz} - a^2z\frac{dV}{dx} = w^2a^2xz.$$

Each of these partial differential equations can be easily integrated, and the value of V, finally obtained, is equivalent to the equation of fluid equilibrium; or

$$V + \frac{w^2}{2}(x^2 + y^2) = C.$$

Let θ represent the complement of the latitude, and ϕ the longitude, counted from the meridian of the greatest axis, then $z = r \cos \theta$, $x = r \sin \theta \cos \phi$, $y = r \sin \theta \sin \phi$, and

$$V + \frac{r^2w^2}{2}\sin^2\theta = C.$$

In the case of an ellipsoid having the ellipticity e, we have, neglecting small terms,

$$r = a\,(1 - e\cos^2\theta).$$

From these equations, and from the properties of Laplace's functions into which V can be expanded, an expression can be obtained of the same kind as that deduced by Professor Stokes from his own and Gauss' theorems relative to attractions.

XXV.—On the Storm of the 9th of February, 1861. By the Rev. Samuel Haughton, F. R. S., Fellow of Trinity College, Dublin. (Plate XI.)

[Read before the Royal Irish Academy, on Monday, February 25, 1861.]

On the 11th instant I expressed to the Academy my opinion, that the disastrous storm of the 9th instant was not a Cyclone, and that its occurrence could not therefore be predicted from barometrical observations made in a single locality. Further inquiry into the circumstances of this storm shows that this opinion was correct, and that it constitutes an admirable example of Dove's second kind of storm, outside the limits of the Trade winds (Ueber das Gesetz der Stürme, p. 48.) In this class of storms, there is a direct opposition between the S. W., or equatorial current, and the N. E., or Polar current, of air; there is generally a succession of non-cyclonic gales, N. E. and S. W.; and when the S. W. wind gives place to the N. E., there is a rising barometer and minimum temperature corresponding to the time of the storm. The following facts place the peculiar and non-cyclonic character of this storm beyond all doubt.

Dublin.—In this city a wave of atmospheric pressure occurred, of 8 days, 4 hours' duration, the two crests of the wave being—

1st crest, Feb. $1^d\ 22^h$; Barom. = 30·70 in.
2nd crest, Feb., $10^d\ 2^h$; Barom. = 30·48 in.

And the hollow of the wave being—

Feb. $5^d\ 2^h$; Barom. = 29·00 in.

The gale or storm occurred of maximum violence,—

Feb. $9^d\ 22^h$, velocity 24 miles per hour.

The accompanying Table shows all the circumstances of the week preceding the storm :—

MAGNETICAL OBSERVATORY, TRINITY COLLEGE, 1861.

February.	Barometer, 1861.				Direction of Wind.			
	10 A. M.	1 P. M.	6 P. M.	10 P. M.	10 A. M.	1 P. M.	6 P. M.	10 P. M.
1, .	29·870	30·051	30·467	30·595	N. W.	N. W.	N. W.	W. N. W.
2, .	30·724	30·674	30·628	30·590	S. W.	S. W.	S. W.	S. W.
4, .	29·836	29·820	29·790	29·718	W. S. W.	W. S. W.	S. W.	S. S. W.
5, .	29·273	29·168	29·058	29·029	S.	S. S. W.	S. S. W.	S. S. W.
6, .	29·040	29·058	29·215	29·287	S. S. W.	S. W.	S. W.	S. W.
7, .	29·482	29·458	29·586	29·625	S. W.	W. S. W.	W.	W.
8, .	29·704	29·700	29·718	29·785	N.	N.	N. N. E.	N. N. E.
9,*.	29·982	30·048	30·228	30·316	N. N. E.	N. N. E.	N. E.	N. E.
11, .	30·180	30·087	29·990	29·929	N. E.	N. E.	E.	S. E.
12, .	29·707	29·670	29·610	29·585	N. E.	E. N. E.	S. E.	S. E.
13, .	29·738	29·781	29·879	29·932	S. E.	S. E.	S. E.	S. E.
14, .	29·880	29·745	29·669	29·602	S.	S. S. E.	S. S. E.	S. S. E.
15, .	29·425	29·363	29·333	29·377	S. S. E.	S. S. E.	S. S. E.	S. S. E.
16, .	29·568	29·531	29·533	29·541	S. W.	S. S. E.	S.	S.
18,†.	29·509	29·511	29·488	29·371	S. E.	S. E.	S. E.	S. E.
19, .	29·102	29·242	29·472	29·472	S.	S. W.	S.	S. S. E.
20, .	29·156	29·158	29·156	29·088	S. S. E.	S. S. W.	S.	S. S. E.
21,‡.	29·137	28·964	28·959	29·190	S.	S. E.	W.	S. S. W.
22, .	29·451	29·526	29·572	29·604	S. S. W.	S. S. W.		
23, .	29·740	29·758	29·896	29·982				
25, .	30·296	30·244						

* *Storm* at Dublin from N. N. E. Same point throughout. Velocity of wind, 24 miles per hour.

† *Gale* at Drogheda, Dublin, Dunmore East, and Penzance, from S. E. Same point throughout.

‡ *Storm* in London, Chichester, and Plymouth; gale in Dublin at midnight. At 7 P.M. in London the pressure was 36 lbs. per foot.

Wind in Dublin at same point throughout,—S. S. W.

From this Table it also appears that the equatorial wind (S. W.) continued from the 2nd of February, to the evening of the 7th of Feb., when it gave way to a West wind, then a North wind, and finally settled at 10, P. M., of the 8th, into a N. N. E. polar current, at which point it held throughout the storm, which reached its maximum twelve hours after the N. N. E. wind began to blow. On the night of the 9th of February it blew from the N. E., and so continued for 40 hours afterwards. The temperatnre, during the prevalence of the S. W. wind, and falling barometer, was mild, and the air damp, producing a feeling of closeness, from the vapour present in the air. For eight days previous to the minimum height of the barometer, the mean temperature was 49°·7; while during the three days following the minimum of the barometer, the mean temperatures were—

Feb. 7, at 10 A. M., . .	42°·5	
,, 8, ,, ,, . .	40 ·8	
,, 9, ,, ,, . .	35 ·1	maximum of gale.
Mean, . .	39°·4	

This shows a rising barometer, a falling thermometer, reaching a *maximum* and *minimum*, respectively, at the time of the storm; and on the 8th and 9th of February heavy hail showers fell at intervals. Such a phenomenon cannot by possibility be confounded with a Cyclone, which has a *minimum* barometer just before, and in the middle of the storm, and no such relation of the gale to temperature as Dove has pointed out in the class of storms to which that of the 9th of February unquestionably belongs. The storm of the 9th was also only the first of a series, arising from the same cause, viz., the direct and non-cyclonic collision of the equatorial and polar currents of air.

I have drawn in Plate XI. the curve of Barometric Pressure at 10 A. M. and 10 P. M. for the week preceding the 9th of February, and also the curve of Temperature at 10 A. M. during the same period. These curves show at a glance that the storm occurred on the maximum of pressure and minimum of temperature; that the rising barometer occurred with a wind shifting from S.W. by W. and N. to N. E., and that the curve of temperature is inverse to the curve of pressure. Combining these facts with the fact that the wind continued for twenty hours in the N. N. E., and for twenty hours more in the N. E., the storm occurring during the first of those periods, I believe it impossible to suppose that any Cyclonic movement could account for such a combination of circumstances. The succession of gales from the 9th to the 21st of February was due to the Equinoctial gales arriving this year before their time, as is indicated by the high temperature and great moisture of the month, and by the excessive rain-fall, occasioned by the conflict of the polar and equatorial currents, unusual at so early a period in the year.

A *second* gale occurred on the night of the 18th, which was felt severely at Drogheda, Dunmore East, and Penzance, and caused the loss of several vessels; at all three places the wind blew steadily from the S. E.

A *third* storm has been reported from London, Chichester, Plymouth, and other places, on the evening of the 21st of February. It was felt in Dublin early on the morning of the 22nd, from the S. S. W., but not severely. At 7 P. M., in London, it was at its height, and is said to have reached 36 lbs. per foot; and it had sufficient force to blow down the spire of Chichester Cathedral.

According to Dove's theory, these two storms are supplements to the storm of the 9th, and not distinct cyclonic movements.

Limerick.—I have ascertained from a respected correspondent in this city, that the barometer was rising slowly and steadily on the 3rd and 4th; during the night of the 4th it rose rapidly, and on the morning of the 5th it was over 30·5 inches. On the evening of the 5th, it began to fall, and continued to do so until the 9th, when the storm occurred at Dublin, at which time the barometer in Limerick stood at 29 inches. There was no storm felt in Limerick. It thus appears that the atmospheric curve in Dublin was the inverse of that in Limerick; and that on the mornings of the 5th and 9th there was a difference of pressure in these cities of above one inch, in opposite directions. Although the barometer in Dublin or Limerick alone would not have enabled an observer to predict a storm, yet any person acquainted with the condition of the barometer at both places might fairly have expected rough weather from the N. E., such as actually occurred on the morning of the 9th of February, in Dublin.

Mr. Haughton then read to the Academy the following letter from Mr. Robert H. Scott:—

"13, *Suffolk-street, February* 22, 1861.

"Dear Mr. Haughton,—I see by your remarks at the last Meeting of the Royal Irish Academy, that it is your opinion that the storm of the 9th instant could not have been predicted from observations of the barometer here in Dublin. I think, therefore, that it may interest you to compare the behaviour of the barometer and thermometer in the British Islands during the past month with the records of their behaviour throughout Europe in seasons similar to the present. You are aware that Professor Dove, in his Law of Storms (Berlin, 1857), whom I quoted in a letter to 'Saunders' News-Letter,' on the 12th, classifies all storms under three heads.

"I. Cyclones.—Arising within the zone of the trades from the interference of the return with the normal current.

"II. Gales.—Arising outside these limits, from the meeting of the two currents (equatorial and polar) blowing in directions opposite to each other.

"III. Gales arising from the lateral interference of these currents when they are, as is frequently the case, flowing in directions opposite to each other in parallel channels.

"The first class is fully treated of by the late General W. Reid. Cyclones are always preceded by a fall of the barometer; and the direction of the wind changes according to fixed laws during their continuance.

"The second class cannot be predicted by insulated observations at any one point, but requires a large amount of data obtained from localities scattered over a wide area of country. They are indicated by the co-existence of a high barometer and low thermometer over the eastern portion of that area, while to the westward the instruments show great rarefaction of the air, and a mild temperature. In this case there is usually a succession of alternating N. E. and S.W. gales, separated by some days from each other. *There is no rotation of the wind* during these storms.

"The third class is rare. It arises from the fact that when the polar and equatorial currents are flowing in parallel channels, the latter will assume a more westerly direction than the former does easterly, owing to their friction against the earth's surface. There will, therefore, if the equatorial current lie to the southward, be a partial vacuum in it, and a liability to a N. W. storm, during which the barometer will rise; or, if the polar current lie to the south there will be a cyclone generated in it.

"If you will allow me to quote two cases from Dove's 'Mean Temperature for every five days' (Fünftägige Mittel, Berlin, 1856), I think that you will see that I may be justified in referring the storm in question to Dove's second class. I shall take the winters of 1850 and 1855.

"The cold in the north of Europe in January, 1850, was very intense, and reached a maximum about the 20th of the month This intensity was only felt at the stations situated at a low level, as the temperature at the Brocken, at an elevation of 3500 ft., was 28° F. above what it was at Heiligenstadt, twenty miles S. W. from that mountain. The barometer stood 9 lines above its mean level, along a line from Königsberg to Prague. On the same day there was a barometric minimum of 8·5 lines at North Salem in the state of New York. In this case we find the oscillations of the barometer, and the accompanying storms of wind and snow at Vienna. From the 19th, on which day there was a violent snow-storm, it rose 15 lines in two days, and the thermometer sunk to − 7°·6 F. On the 23rd the barometer fell again rapidly, and a N.N.W. storm, accompanied by a snow-fall of unusual magnitude ensued. In this case, we have at Vienna, lying on the line of contact of the two areas above referred to, a N.W. storm *preceded by a fall of the barometer*.

"On the other hand, E. storms, *accompanied by a rising* barometer, are recorded on two occasions in the winter of 1855–56.

"The autumn of 1855 was very warm and wet in the Mediterranean, while in the North of Germany it was marked by its extreme dryness, up to the end of October. In the middle of December the barometer rose to a great height over the whole of North Germany, the temperature sinking proportionably. From the 18th to the 21st a violent N. E. storm raged in the Black Sea, the Caledonia was lost at Sebastopol, and a fleet of ships were wrecked at the Sulina mouth of the Danube. Simultaneously with it there set in a violent S. E. storm in the British

Channel, and on the south coast of Ireland, while the lowest temperature at Greenwich was felt on the 22nd. Hence we see that the polar current had gradually forced its way to the west. This barometric maximum was succeeded by a minimum on the 8th of January, 1856, at which time a violent N. E. storm was felt over the greater part of the United States. In Europe a second maximum occurred on the 13th, and its advent was marked by a N. E. storm and sudden fall of temperature on the lower Danube. After this violent S. W. gales set in on the south coast of France and Spain, and the fall of the barometer was the precursor of a long spell of warm weather.

"In the case of the present winter we have had here in Ireland a low barometer and very mild weather, while in England the frost continued with undiminished intensity. We were, therefore, as I think, in the position described by Professor Dove, p. 289 :—

"'Should the barometer oscillate, and yet the air remain at rest, the cause of the disturbance is at some distance. At times, in winter, the southerly current maintains its ground over a large area to such an extent that the air is delightfully mild, the barometer being low meanwhile. In this case there is somewhere in the neighbourhood a district where the barometer is high, and the weather very cold. *This cold air may then suddenly force its way into the rarefied air in its neighbourhood, as a storm, causing the barometer to rise rapidly.*'

"I need not say that these views are an attempt to represent the published opinions of Professor Dove, under whom I have studied; and I cannot better conclude this letter than by giving you a confirmation of this theory which I have lately met with; it is from a paper by M. Spassky, entitled, 'Note sur la tempête d'hiver, &c., &c., entre le 9–11 Dec., 1850.' In explanation, I may say that there was on the 23rd of that month a barometric maximum in Europe, and a simultaneous minimum in America, followed by a violent snow-storm. This had been preceded by a minimum in Russia on the 6th, and a storm on the 9th. The narrative proceeds—'This storm lasted from thirty to forty-eight hours, between the 9th and 11th, without intermission. Before the gale it had been thawing; but the first gust caused the thermometer to fall 15° or 20° R. below Zero, so that persons who were out of doors fell dead, being lost in the driven snow, some close to their own doors. After the storm, 311 persons were found frozen to death in the Government of Kalonga, 140 in that of Tula, and 39 in the district of Kursk. It is probable that many more are as yet undiscovered, owing to the depth of snow. Houses were blown down, and even horses yoked to the sleighs were frozen to death. This atmospheric revolution was the result of the struggle between the two currents of air, by means of which Professor Dove's theory enables us to explain most atmospheric phenomena: and yet many physicists continue to dispute its truth, in the face of plain proofs like the above, which cannot be explained on any other hypothesis. In order to convince us that all the characteristic phenomena of the atmosphere were in exact accordance with Professor Dove's theory during this storm, we need only refer to the observations at Mos-

cow. Before the 6th the Polar current prevailed there, N. wind, barometer 336·27 lines, and thermometer 14° 5 R. On the 6th the equatorial current appeared, barometer fell 15·53 lines before the 9th; the thermometer rose 12° 9, and the wind veered through S. to S. W. The polar current, having thus yielded to the first onset, collected its strength to force its opponent back. On the 9th there was a lull, followed by a north wind lasting up to the 11th, during which time the barometer rose 7·46 lines, and the thermometer fell 15° 4. On the evening of the 11th there was a fresh lull; and on the 12th the equatorial current set in again, as is shown by the wind getting round to S. W., the thermometer rising above Zero, and the barometer falling 6·06 lines.'

"Yours very sincerely,

"ROBERT H. SCOTT.

"*Rev. Professor Haughton.*"

(*Continued from page 96.*)

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sh.	Carb Sl.	Lower Li.	Calp, or Mid. Li.	Upper Li.
Macrocheilus	imbricatus,					*		
"	fimbriatus,			*				
"	ovalis,			*				
"	parallelus,					*		
"	rectilineus,					*		
Loxonema	brevis,					*		
"	constricta,				*	*		
"	impendens,					*		
"	polygyra,			*		*		
"	pulcherrima,				*			
"	sulcatula,	*						
"	sulculosa,				*	*	*	
"	tumida,			*	*	*		
PHYTOPHAGA.			*	*	*	*	*	*
Turritella	acicula,			*				
"	megaspira,					*		
"	suturalis,					*		*
"	tenuistria,		*			*		
Turbo	spirata,		*					
Lacuna	antiqua,						*	
Naticopsis	canaliculata,					*		
"	dubia,					*		
"	elongata,		*			*		
"	neritoides,					*		
"	Phillipsii,					*		*
"	plicistria,				*	*		
"	spirata,		*					*
Euomphalus	acutus,			*	*	*		
"	æqualis,				*	*		
"	anguis,					*		
"	calyx,			*		*	*	
"	catillus,		*	*				
"	cristatus,					*		
"								
"	crotalostomus,					*	*	
"	elongatus,		*					
"	marginatus,		*					
"	neglectus,					*		
"	pentangulatus,		*	*		*	*	
"	pileopsideus,					*		
"	quadratus,			*				
"	rotundatus,		*		*	*		
"	serpens,			*	*			
"	tabulatus,		*	*	*	*		
Platyschisma	Cirroides,					*		
"	Helicoides,					*		
"	Jamesii,					*		
"	zonites,					*		
Pleurotomaria	altavittata,			*				

Names of Fossils		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp, or Mid. Li.	Upper Li.
Pleurotomaria	canaliculata,	. .	. .	*	*	. .	. .	. .
"	carinata,	. .	. .	. .	*	*	. .	. .
"	concentrica,	. .	. .	. .	*	*	. .	. .
"	conica,	. .	. .	. .	*	. .	. .	. .
"	decussata,	. .	. .	. .	. .	*	. .	. .
"	filosa,	. .	. .	. .	. .	*	. .	. .
"	Griffithii,	. .	. .	. .	. .	*	. .	. .
"	Hainesii,	. .	. .	. .	. .	*	. .	. .
"	lenticula,	. .	. .	. .	. .	*	. .	. .
"	multicarinata,	. .	. .	. .	. .	*	. .	. .
"	tornatilis,	. .	. .	. .	*	. .	. .	. .
Murchisonia	elongata,	. .	. .	*	. .	. .	. .	. .
"	Larcomi,	. .	. .	*	. .	. .	. .	. .
"	quadricarinata,	. .	. .	. .	. .	. .	. .	*
Elenchus	antiquus,	. .	. .	*	. .	. .	. .	. .
"	subulatus,	. .	. .	. .	. .	*	. .	. .
Scutibranchia and Cyclobranchia.		. .	. .	*	*	*	*	*
Trochella	prisca,	. .	. .	. .	. .	*	. .	. .
Fissurella	elongata,	. .	. .	. .	*	. .	. .	. .
Dirinus	Bucklandi,	. .	. .	. .	. .	. .	*	. .
Acroculia	angustata,	. .	. .	. .	. .	*	. .	. .
"	canaliculata,	. .	. .	. .	. .	*	. .	. .
"	carinata,	. .	. .	. .	. .	*	. .	. .
"	sigmoidalis,	. .	. .	*	. .	. .	. .	. .
"	triloba,	. .	. .	. .	*	*	. .	. .
"	tubifer,	. .	. .	. .	*	*	. .	. .
"	vetusta,	. .	. .	. .	*	*	. .	*
Patella	mucronata,	. .	. .	*	. .	*	. .	. .
"	scutiformis,	. .	. .	. .	*	*	. .	. .
"	sinuosa,	. .	. .	. .	. .	*	*	. .
Siphonaria	Konincki,	. .	. .	. .	. .	*	. .	. .
Umbrella	lævigata,	. .	. .	. .	. .	*	. .	. .
Dentalium	inornatum,	. .	. .	. .	. .	*	. .	. .
Dythyra.		*	*	*	*	*	*	*
Macrotrachia.		*	*	*	*	*	*	*
Teredo (?)	antiqua,	. .	*	. .	. .	. .	. .	. .
Solenopsis	minor,	. .	. .	. .	. .	. .	. .	*
Sanguinolites	angustatus,	. .	*	*	*	. .	*	. .
"	arcuatus,	. .	*	. .	. .	*	. .	. .
"	contortus,	. .	. .	. .	. .	*	. .	. .
"	costellatus,	. .	. .	*	. .	. .	. .	. .
"	curtus,	. .	. .	. .	. .	. .	*	. .
"	discors,	. .	. .	*	. .	. .	. .	. .
"	Iridinoides,	. .	. .	. .	*	. .	*	*
"	plicatus,	. .	*	*	*	. .	*	. .
"	radiatus,	. .	. .	. .	. .	. .	. .	*

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp, or Mid. Li.	Upper Li.
Sanguinolites,	sulcatus,		*			*		
"	transversus,	*		*				
"	tricostatus,		*					
"	tumidus,					*		
"	undatus,			*				
Anatina	attenuata,		*					
"	deltoida,		*		*			
Pandora	clavata,				*			
Edmondia (?)	compressa,					*		
Lutraria	prisca,					*		*
Mactra	incrassata,					*		
"	ovata,		*					
Kellia	gregaria,			*				
Psammobia	decussata,					*		
Lucina	antiqua,						*	
Ungulina	"						*	
Amphidesma	subtruncatum,					*	*	
Corbis	cancellata,					*		
Venus	centralis,			*				
"	tenuistria,				*			
Pullastra	bistriata,				*			
"	crassistria,		*					
"	elliptica,			*	*			
"	ovalis				*			
Astarte	gibbosa,			*				
"	quadrata,				*			
Cyprina	Egertoni,		*	*		*		
Donax	primigenius,					*		
Cardium	orbiculare,					*		
Cardiomorpha	Axiniformis,					*		
"	corrugata,					*		
"	oblonga,					*		
"	ventricosa,					*		
Pleurorhynchus	aliformis,				*			
"	armatus,				*			
"	fusiformis,				*			
"	giganteus,		*		*		*	
"	Hibernicus,					*		
"	inflatus,					*		
"	minax,			*	*	*	*	
"	nodulosus,						*	
"	trigonalis,				*	*		
Cypricardia	alata,		*	*				
"	concinna,			*				
"	cuneata,		*					*
"	cylindrica,		*					
" (? Sedgwickia)	minima,		*					
"	modiolaris,		*					
"	oblonga,		*					

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp, or Mid. Li.	Upper Li.
Cypricardia	quadrata, .	. .	*	. .	. .	. .	. .	. .
"	rhombea, . .	. .	. .	. .	*	. .	. .	. .
"	sinuata, . . .	. .	*	. .	. .	. .	. .	. .
"	socialis, . . .	. .	. .	*	. .	. .	. .	. .
"	subtruncata, .	. .	. .	. .	. .	. .	*	. .
"	tumida, . . .	. .	. .	*	. .	. .	. .	. .
Sedgwickia	attenuata, . .	. .	. .	*	. .	. .	. .	. .
"	bullata, . . .	. .	. .	*	. .	. .	. .	. .
"	gigantea, . .	. .	. .	. .	*	. .	. .	. .
"	globosa, . . .	. .	. .	*	. .	. .	. .	. .
Axinus	axiniformis, .	. .	. .	*	. .	. .	. .	. .
"	carbonarius, .	. .	. .	*	. .	. .	. .	. .
"	centralis, . .	*	. .	. .	. .	. .	. .	. .
"	deltoideus, . .	. .	. .	*	. .	. .	. .	. .
"	nuculoides, . .	. .	. .	*	. .	. .	. .	. .
"	obliquus, . .	. .	. .	*	. .	. .	. .	. .
"	obovatus, . .	. .	. .	*	. .	. .	. .	. .
Delabra	attenuata, . .	. .	. .	. .	*	. .	. .	. .
"	equilateralis, .	. .	. .	. .	*	. .	. .	. .
"	gregaria, . .	. .	. .	*	. .	. .	. .	. .
"	orbicularis, . .	*	. .	. .	. .	. .	. .	. .
"	rectangularis, .	. .	. .	. .	. .	. .	*	. .
"	securiformis, .	. .	. .	*	. .	. .	. .	. .
Leptodomus	fragilis, . . .	. .	. .	. .	. .	*	. .	. .
"	senilis, . . .	. .	. .	. .	. .	*	. .	. .
Venerupis	cingulatus, . .	. .	. .	. .	. .	*	. .	. .
"	obsoletus, . .	. .	. .	. .	. .	*	. .	. .
"	scalaris, . .	. .	. .	. .	. .	*	. .	. .
Atrachia.		*	*	*	*	*	*	*
Nucula	attenuata, . .	. .	. .	. .	*	. .	*	*
"	birostrata, . .	. .	. .	. .	*	. .	. .	. .
"	brevirostris, .	. .	. .	. .	*	. .	. .	. .
"	carinata, . .	. .	. .	. .	*	. .	. .	. .
"	clavata, . . .	. .	. .	*	. .	. .	. .	. .
"	cylindrica, . .	. .	*	. .	. .	. .	*	. .
"	gibbosa, . .	. .	. .	*	*	. .	. .	. .
"	leiorynchus, .	. .	. .	*	. .	. .	. .	. .
"	longirostris, .	. .	. .	*	. .	. .	. .	. .
"	oblonga, . .	. .	. .	*	. .	. .	. .	. .
"	Phillipsii, . .	. .	. .	*	*	. .	*	. .
"	rectangularis, .	. .	. .	. .	*	*	. .	. .
"	stilla, . . .	. .	. .	*	. .	. .	. .	. .
"	unilateralis, .	. .	. .	. .	*	. .	. .	. .
Arca	cancellata, . .	. .	. .	. .	. .	. .	. .	*
"	fimbriata, . .	. .	. .	. .	. .	*	. .	. .
Cucullæa	arguta, . . .	. .	. .	. .	. .	*	. .	*
"	tenuistria, . .	. .	. .	*	. .	*	. .	. .
Byssoarca	clathrata, . .	. .	. .	. .	. .	. .	*	. .
"	costellata, . .	. .	. .	. .	. .	. .	. .	*

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp. or Mid. Li.	Upper Li.
Byssoarca	lanceolata,				*			
"	obtusa,					*		
"	reticulata,					*	*	*
"	semicostata,						*	
Crenella	acutirostris,			*				
Modiola	amygdalina,				*			
"	concinna,		*					
"	divisa,			*				
"	lingualis,			*				
"	Macadami,			*				
"	megaloba,	*						
"	patula,					*		
"	subparallela,		*					
Lithodomus	dactyloides,					*		
Lanistes	obtusus,							*
Mytilus	comptus,				*			
"	Flemingi,					*		
Inoceramus	lævissimus,					*		
"	orbicularis,					*		
"	pernoides,					*		
"	vetustus,	*				*		*
Posidonia	Becheri,						*	
"	costata,						*	
"	lateralis,						*	
"	membranacea,						*	
"	similis,						*	
"	tuberculata,						*	
Meleagrina	lævigata,					*		
"	pulchella,					*		
"	quadrata,					*		*
"	radiata,					*		*
"	rigida,				*			
"	tessellata,				*			*
Pteronites	angustatus,			*	*			
"	latus,					*		
"	semisulcatus,							*
"	sulcatus,						*	
"	ventricosus,	*						
Avicula	angusta,			*				
"	cycloptera,				*			
"	flabellulum,						*	
"	gibbosa,							*
"	informis,		*					
"	laminosa,			*		*	*	
"	lævigata,					*		
"	lunulata,					*		
"	recta,					*		
"	squamosa,						*	
"	Thompsoni,				*			
"	Verneuillii,			*				
Pinna	flabelliformis,					*		

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp. or Mid. Li.	Upper Li.
Pinna	flexicostata,	. .	. .	. .	*	. .	. .	. .
"	inequicostata,	. .	. .	. .	. .	. .	*	. .
"	mutica	. .	*	. .	. .	. .	. .	. .
Lingula	squamiformis?	. .	. .	*	. .	. .	. .	. .
Anomia	antiqua,	. .	. .	. .	. .	*	. .	. .
Malleus	orbicularis,	. .	. .	. .	*	. .	. .	. .
Lima	alternata,	. .	. .	. .	. .	*	. .	*
"	concinna,	. .	*	. .	. .	. .	. .	. .
"	decussata,	. .	. .	. .	. .	. .	. .	*
"	lævigata,	. .	. .	. .	. .	*	. .	*
"	obliqua,	. .	. .	. .	. .	. .	*	. .
"	planicostata,	. .	. .	*	. .	. .	. .	. .
"	prisca,	. .	. .	. .	. .	*	. .	. .
"	semisulcata,	. .	. .	. .	. .	. .	*	. .
Pecten	æqualis,	. .	. .	. .	. .	. .	. .	*
"	arachnoideus,	. .	. .	. .	*	. .	. .	. .
"	arenosus,	. .	. .	. .	. .	*	. .	*
"	asperulus,	. .	. .	. .	. .	. .	. .	*
"	bellis,	. .	. .	. .	*	. .	. .	. .
"	cancellatulus,	. .	. .	. .	. .	. .	. .	*
"	cingendus,	. .	. .	. .	. .	. .	*	. .
"	clathratus,	. .	. .	. .	. .	*	. .	. .
"	cælatus,	. .	. .	. .	. .	*	. .	. .
"	concavus,	. .	*	. .	. .	. .	. .	. .
"	concentrico-striatus,	. .	. .	. .	. .	*	. .	*
"	conoideus,	. .	*	. .	. .	. .	. .	. .
"	consimilis,	. .	. .	. .	*	. .	. .	. .
"	deornatus,	. .	. .	. .	. .	*	. .	. .
"	depilis,	. .	*	. .	. .	. .	*	. .
"	dissimilis,	. .	. .	. .	. .	*	. .	. .
"	duplicicosta,	. .	. .	*	. .	. .	. .	. .
"	ellipticus,	. .	*	*	*	*	*	*
"	elongatus,	. .	. .	. .	. .	*	. .	. .
"	fallax,	. .	. .	. .	*	*	. .	. .
"	filatus,	. .	. .	*	. .	*	. .	. .
"	flabellulum,	. .	. .	. .	. .	. .	. .	*
"	flexuosus,	. .	. .	. .	. .	*	. .	. .
"	Forbesii,	. .	. .	. .	. .	*	. .	. .
"	gibbosus,	. .	. .	. .	. .	*	. .	*
"	granosus,	. .	. .	. .	*	*	. .	*
"	granulosus,	. .	. .	. .	*	. .	*	*
"	Hardingii,	. .	. .	. .	*	. .	. .	. .
"	hians,	. .	. .	. .	. .	*	. .	. .
"	incrassatus,	. .	. .	. .	*	. .	. .	. .
"	intercostatus,	. .	. .	. .	. .	*	. .	*
"	interstitialis,	. .	. .	*	*	. .	*	*
"	irregularis,	. .	. .	. .	*	. .	. .	. .
"	Jonesii,	. .	. .	. .	. .	. .	. .	*
"	Knockonniensis	. .	*	. .	. .	. .	. .	. .
"	macrotis,	. .	. .	*	. .	. .	. .	. .
"	megalotis,	. .	. .	. .	*	. .	*	*

Names of Fossils.		Yellow Sandstone Group				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp. or Mid. Li.	Upper Li.
Pecten	micropterus, .	. .	. .	*	. .	. .	. .	. .
”	mundus, . .	. .	. .	. .	*	*	. .	. .
”	Murchisonii, .	. .	. .	. .	*	*	. .	. .
”	ovatus, . . .	. .	. .	. .	. .	*	. .	. .
”	pera, . . .	. .	. .	*	. .	. .	. .	. .
”	planicostatus, .	. .	. .	. .	. .	*	. .	. .
”	plano-clathratus	. .	. .	. .	.	. .	*	. .
”	plicatus, . .	. .	. .	. .	*	*	*	. .
”	polytrichus, .	. .	. .	*	. .	. .	*	. .
”	quinquelineatus	. .	. .	. .	*	. .	. .	. .
”	rugulosus, . .	. .	. .	. .	*	. .	. .	. .
”	scalaris, . .	. .	. .	. .	*	. .	. .	. .
”	sclerotis, . .	. .	. .	. .	. .	. .	*	. .
”	Sedwickii, . .	. .	. .	. .	. .	*	. .	. .
”	segregatus, .	. .	. .	. .	. .	. .	*	. .
”	semicircularis, .	. .	. .	*	*	. .	. .	. .
”	semistriatus, .	. .	. .	. .	. .	*	. .	. .
”	serratus, . .	. .	. .	. .	*	. .	. .	. .
”	simplex, . .	. .	. .	*	. .	. .	. .	. .
”	Sowerbii, . .	. .	. .	*	*	*	*	. .
”	spinulosus, . .	. .	. .	*	. .	. .	. .	. .
”	tabulatus, . .	. .	. .	. .	. .	. .	*	. .
”	transversus, .	. .	. .	. .	*	. .	. .	. .
”	tripartitus, . .	. .	. .	. .	. .	. .	. .	*
”	undulatus, . .	. .	. .	. .	*	. .	. .	. .
”	variabilis, . .	. .	. .	. .	. .	. .	*	. .
Monotis	æqualis, . .	. .	. .	*	. .	. .	. .	. .
Brachiopoda.		*	*	*	*	*	*	*
Orbiculidæ.		*	*	*	*	*	*	*
Orbicula	nitida, . . .	. .	. .	. .	. .	. .	*	. .
”	quadrata, . .	. .	. .	*	. .	. .	. .	. .
”	trigonalis, . .	. .	. .	. .	*	. .	. .	. .
Athyridæ.		*	*	*	*	*	*	*
Crania	vesiculosa, . .	. .	. .	. .	. .	*	. .	. .
Calceola	sandalina, . .	. .	. .	. .	. .	*	. .	. .
Producta	aculeata, . .	. .	*	. .	*	*	*	*
”	antiquata, . .	. .	. .	. .	*	*	*	. .
”	aurita, . . .	. .	. .	. .	. .	*	. .	. .
”	caperata, . .	. .	. .	*	*	. .	. .	. .
”	concinna, . .	. .	. .	*	*	*	*	*
”	corrugata, . .	. .	. .	*	*	*	*	*
”	costellata, . .	. .	. .	. .	. .	. .	. .	*
”	Edelburgensis, .	. .	. .	. .	. .	*	. .	*
Producta	elegans, . .	. .	. .	*	. .	*	*	*
”	fimbriata, . .	. .	*	. .	*	*	*	. .
”	flexistria, . .	. .	. .	. .	. .	*	. .	. .

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp. or Mid. Li.	Upper Li.
Producta	fragaria, . .	. .	. .	. .	*	*	. .	. .
"	gigantea, . .	. .	*	. .	. .	*	. .	*
"	granulosa, . .	. .	. .	. .	*	*	*	*
"	hemispherica, .	. .	*	. .	*	*	*	. .
"	intermedia, .	. .	. .	. .	. .	*	. .	. .
"	interrupta, . .	. .	. .	. .	*	. .	. .	. .
"	laciniata, . .	. .	. .	. .	. .	*	. .	. .
"	latissima, . .	. .	. .	. .	*	*	*	*
"	laxispina, . .	. .	*	. .	. .	*	. .	*
"	lirata, . . .	. .	. .	.	. .	*	. .	. .
"	lobata, . . .	. .	. .	*	*	. .	*	. .
"	longispina, . .	. .	. .	. .	*	. .	*	. .
"	margaritacea, .	. .	. .	*	*	*	*	. .
"	Martini, . .	. .	. .	. .	*	*	*	*
"	maxima, . .	. .	. .	. .	. .	*	. .	. .
"	membranacea, .	. .	. .	. .	*	. .	*	. .
"	mesoloba, . .	. .	. .	. .	*	*	. .	*
"	muricata, . .	. .	. .	. .	. .	*	. .	. .
"	ovalis, . . .	. .	. .	. .	*	*	*	. .
"	pectinoides, .	. .	. .	. .	*	*	*	*
"	prælonga, . .	*	. .	. .	*	. .	. .	. .
"	pugilis, . . .	. .	. .	. .	*	*	*	*
"	punctata, . .	. .	*	. .	*	*	*	*
"	pustulosa, . .	. .	. .	. .	*	*	. .	*
"	quincuncialis, .	. .	. .	*	*	*	*	*
"	rugata, . . .	. .	. .	. .	*	*	*	*
"	scabricula, . .	. .	. .	*	*	*	*	*
"	Scotica, . . .	. .	*	*	*	*	*	*
"	setosa, . . .	*	. .	*	*	*	*	*
"	spinosa, . . .	. .	. .	*	*	*	*	*
"	striata, . . .	. .	. .	. .	. .	*	. .	. .
"	sublævis, . .	. .	. .	. .	. .	*	. .	. .
"	sulcata, . . .	. .	. .	*	*	*	*	*
"	tortilis, . . .	. .	*	. .	. .	. .	. .	. .
Leptagonia	analoga, . .	. .	. .	. .	*	*	*	*
"	depressa, . .	. .	. .	. .	. .	. .	. .	. .
"	multirugata, .	. .	. .	. .	. .	*	. .	. .
"	nodulosa, . .	. .	. .	. .	*	. .	. .	. .
"	plicatilis, . .	. .	.	. .	*	*	. .	*
"	rugosa, . . .	. .	. .	. .	*	. . .	. .	. .
Leptæna	sp. ?	. .	. .	. .	. .	*	. .	. .
"	convoluta, . .	. .	. .	. .	*	. .	*	. .
"	crassistria, . .	. .	. .	. .	. .	. .	*	. .
"	Dalmaniana, .	. .	. .	. .	*	. .	. .	. .
"	Hardrensis, .	. .	. .	*	*	*	*	*
"	lata ? . .	. .	. .	*	. .	. .	. .	. .
"	multidentata, .	. .	. .	*	*	. .	. .	. .
"	papyracea, . .	. .	. .	. .	. .	. .	*	. .
"	perlata, . . .	. .	. .	. .	*	. .	. .	. .
"	plicata, . . .	. .	. .	. .	*	. .	. .	. .
"	sericea ? . . .	. .	. .	. .	*	. .	. .	. .

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp, or Mid. Li.	Upper Li.
Leptæna	serrata, . . .	...	..	..	..	*	..	..
"	sordida, . .	..	..	*	*	..	*	..
"	volva, . . .	..	..	..	*	*	*	..
Delthyridæ.		*	*	*	*	*	*	*
Orthis	arachnoidea, .	..	..	..	*	..	..	..
"	arcuata, . .	*	..	..	*	..	*	..
"	Bechei, . . .	..	..	..	*	..	..	..
"	caduca, . . .	..	..	..	*	..	..	..
"	circularis, . .	..	..	..	*	..	..	..
"	comata, . . .	..	..	..	*	..	..	..
"	connivens, . .	..	..	..	..	*	..	..
"	crenistria, . .	*	..	*	*	*	*	*
"	cylindrica, . .	..	*	..	..	..	..	..
"	divaricata, . .	..	..	..	..	*	..	..
"	filiaria, . . .	..	..	*	*	*	*	*
"	gibbera, . .	..	..	..	..	*	..	..
"	granulosa, . .	..	..	*	*	..	..	..
"	interlineata, .	..	..	..	*	..	..	..
"	Kellii, . . .	..	..	..	..	*	..	..
"	latissima, . .	..	..	*	*	..	..	..
"	longisulcata, .	..	..	..	*	*	..	..
"	papilionacea, .	..	..	*	*	*	*	..
"	parallela, . .	..	*	..	*	..	*	..
"	quadrata, . .	..	..	..	..	..	*	..
"	radialis, . .	..	..	..	*	*	*	..
"	resupinata, . .	..	..	*	*	*	*	*
"	semicircularis, .	..	..	*	*	..	*	..
"	sulcata, . . .	..	..	*	..	..	..	..
"	tenuistria, . .	..	..	..	*	..	*	..
"	tuberculata,	..	..	..	..	*	..	..
Spirifera	aperturata, . .	..	..	..	*	..	..	..
"	attenuata, . .	..	..	*	*	*	*	*
"	bisulcata, . .	..	..	*	*	*	*	*
"	calcarata, . .	..	*	*	*	*	*	..
"	choristites, . .	..	..	..	..	*	..	..
"	clathrata, . .	..	..	..	*	..	..	..
"	crispa, . . .	*	..	..	*	*	*	..
"	decemcostata, .	..	..	..	..	*	..	..
"	disjuncta, . .	..	..	*	*	*	..	..
"	gigantea, . .	..	..	..	*	*	*	*
"	grandæva, . .	*	..	..	*	..	..	..
"	inornata, . .	*	..	..	*	..	..	..
"	megaloba, . .	..	..	..	*	..	..	..
"	minima, . .	..	*	..	..	..	..	*
"	octoplicata, .	..	..	*	*	*	*	..
"	Ornithorhyncha	..	..	..	..	*	..	..
"	ostiolata, . .	..	*	*	*	*	*	..
"	princeps, . .	..	..	..	..	*	..	..
"	quinqueloba, .	..	..	..	..	*	..	..

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp. or Mid. Li.	Upper Li.
Spirifera	rhomboidea, .	. .	. .	. .	*	*	. .	*
,,	rotundata, . .	. .	. .	. .	*	*	. .	. .
,,	rudis, . . .	. .	. .	. .	*	. .	. .	. .
,,	speciosa, . .	. .	. .	*	*	*	*	*
,,	striata, . . .	. .	. .	. .	. .	*	. .	. .
,,	trigonalis, . .	. .	. .	. .	. .	*	. .	. .
,,	Urii, . .	. .	. .	. .	*	*	. .	. .
Cyrtia	cuspidata, . .	. .	. .	. .	*	*	*	. .
,,	distans, . . .	. .	. .	*	*	*	*	. .
,,	dorsata, . . .	. .	. .	. .	. .	*	. .	. .
,,	laminosa, . .	. .	. .	. .	*	. .	. .	. .
,,	linguifera, . .	. .	. .	*	. .	*	*	*
Cyrtia	mesogonia, . .	. .	. .	. .	*	. .	. .	. .
,,	nuda, . . .	. .	. .	. .	*	. .	. .	.
,,	semicircularis, .	. .	. .	. .	*	*	. .	*
,,	senilis, . . .	. .	. .	. .	. .	*	. .	. .
,,	simplex, . .	. .	. .	. .	*	*	. .	. .
,,	subconica, . .	. .	. .	. .	. .	. .	*	. .
Martinia	decora, . . .	. .	. .	. .	*	*	. .	. .
,,	elliptica, . .	. .	. .	*	*	*	. .	. .
,,	glabra, . . .	. .	. .	. .	*	*	*	. .
,,	oblata, . . .	. .	. .	. .	. .	*	. .	. .
,,	obtusa, . . .	. .	. .	. .	. .	*	. .	. .
,,	phalæna, . .	. .	. .	. .	*	. .	. .	. .
,,	plebeia, . . .	. .	*	. .	*	*	*	*
,,	rhomboidalis, .	. .	. .	. .	. .	*	. .	. .
,,	strigocephaloides,	. .	. .	. .	*	. .	. .	. .
,,	symmetrica, .	. .	. .	. .	. .	*	. .	. .
Reticularia	imbricata, . .	. .	. .	. .	*	*	*	*
,,	lineata, . . .	. .	. .	. .	*	*	. .	. .
,,	microgemma, .	. .	. .	. .	*	. .	*	. .
,,	reticulata, . .	. .	. .	. .	. .	*	. .	*
,,	striatella, . .	. .	*	. .	. .	. .	. .	. .
Brachythyris	duplicicosta, .	. .	. .	*	*	*	*	. .
,,	exarata, . .	. .	. .	. .	. .	*	*	*
,,	integricosta, .	. .	. .	. .	*	*	*	. .
,,	ovalis, . . .	. .	. .	. .	*	*	. .	. .
,,	pinguis, . . .	. .	. .	. .	*	*	*	*
,,	planata, . . .	. .	. .	. .	*	. .	*	. .
,,	planicostata, .	. .	. .	*	. .	*	. .	*
Athyris	concentrica, .	. .	. .	*	*	. .	*	. .
,,	decussata, . .	. .	. .	*	*	*	*	. .
,,	depressa, . .	. .	. .	. .	*	. .	. .	. .
,,	expansa, . .	. .	. .	. .	. .	*	*	. .
,,	fimbriata, . .	. .	. .	. .	*	*	*	*
,,	glabristria, . .	. .	. .	*	*	*	*	. .
,,	globularis, . .	. .	*	. .	*	*	. .	*
,,	hispida, . . .	. .	. .	. .	*	. .	. .	. .
,,	plano-sulcata, .	. .	. .	. .	*	*	. .	. .
,,	squamosa, . .	. .	. .	. .	*	*	. .	. .

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sl.	Carb. Sl.	Lower Li.	Calp, or Mid. Li.	Upper Li.
Athyris ?	triloba, . . .	. .	*	. .	. .	. .	. .	. .
Actinoconchus	paradoxus, . .	. .	. .	. .	. .	*	. .	*
TEREBRATULIDÆ.		*	*	*	*	*	*	*
Atrypa	acuminata, . .	. .	. .	. .	. .	*	. .	. .
"	angularis, . .	. .	. .	*	. .	. .	. .	. .
"	anisodonta, . .	. .	. .	. .	. .	*	. .	. .
"	bifera, . . .	. .	. .	. .	. .	*	. .	. .
"	compta, . . .	. .	. .	*	. .	. .	. .	. .
"	cordiformis, .	. .	. .	. .	. .	*	. .	. .
"	desquamata, .	. .	. .	. .	*	. .	. .	. .
"	excavata, . .	. .	. .	. .	. .	*	. .	. .
"	fallax, . . .	*	. .	*	*	. .	*	. .
"	ferita, . . .	. .	. .	. .	. .	*	. .	. .
"	flexistria, . .	. .	. .	. .	*	. .	. .	*
"	gregaria, . .	. .	*	. .	. .	. .	. .	. .
"	hastata, . . .	. .	. .	*	*	*	*	*
"	indentata, . .	. .	*	. .	. .	. .	. .	. .
"	insperata, . .	. .	. .	. .	*	. .	. .	. .
"	isorhyncha, .	. .	. .	. .	. .	*	. .	. .
"	juvenis, . . .	*	. .	*	*	. .	. .	. .
"	lachryma, . .	. .	. .	. .	*	*	. .	. .
"	laticliva, . .	. .	. .	. .	. .	*	. .	. .
"	laticosta, . .	. .	. .	*	*	. .	. .	. .
"	nana, . . .	. .	. .	. .	*	. .	. .	. .
"	oblonga, . .	. .	. .	. .	*	. .	. .	. .
"	obtusa, . . .	. .	. .	. .	. .	*	. .	. .
"	platyloba, . .	. .	. .	. .	. .	*	. .	. .
"	pleurodon, . .	*	. .	*	*	*	*	*
"	prisca, . . .	. .	. .	. .	*	. .	. .	. .
"	proava, . . .	. .	. .	. .	*	. .	. .	. .
"	pugnus, . . .	. .	. .	. .	*	*	. .	*
"	radialis, . . .	*	. .	*	*	*	. .	. .
"	reniformis, . .	. .	. .	. .	*	*	. .	. .
"	sacculus, . .	. .	. .	*	*	*	. .	*
"	semisulcata, .	. .	. .	. .	. .	. .	*	. .
"	striatula, . .	. .	. .	. .	*	. .	. .	. .
"	sulcirostris, .	. .	. .	*	*	*	*	*
"	triangularis, .	. .	. .	. .	. .	*	. .	. .
"	triplex, . . .	. .	. .	*	. .	. .	. .	. .
"	ventilabrum, .	. .	. .	. .	*	*	*	*
"	virgo, . . .	. .	. .	*	. .	*	. .	. .
Seminula	pentahedra, .	. .	. .	. .	. .	*	*	. .
"	pisum, . . .	. .	. .	. .	. .	*	. .	. .
"	rhomboidea, .	. .	. .	. .	. .	*	. .	*
CRUSTACEA.		. .	*	*	*	*	*	*
Calymene ?	granulata, . .	. .	. .	. .	*	. .	. .	. .
"	lævis, . . .	. .	. .	. .	*	. .	. .	. .

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp. or Mid. Li.	Upper Li.
Calymene	Latreillii,	. .	. .	. .	*	. .	. .	. .
Griffithides	calcaratus,	. .	. .	. .	. .	. .	. .	*
,,	globiceps,	. .	. .	. .	. .	*	. .	. .
,,	obsoletus,	. .	*	. .	*	. .	*	*
Phillipsia	cælata,	. .	. .	. .	. .	*	. .	*
,,	Colei,	. .	. .	. .	*	. .	. .	. .
,, ?	discors,	. .	. .	. .	. .	*	. .	. .
,,	gemmulifera,	. .		. .	*	*	. .	. .
,,	Jonesii,	. .	. .	. .	. .	*	. .	. .
,,	Kellii,	. .	. .	. .	. .	*	. .	. .
,,	mucronata,	. .	. .	. .	*	. .	. .	. .
,,	quadriserialis,	. .	. .	. .	. .	*	. .	. .
,,	truncatula,	. .	. .	. .	*	*	. .	. .
Dithyrocaris	Colei,	. .	. .	*	. .	. .	. .	. .
,,	Scouleri,	. .	. .	*	. .	. .	. .	. .
,,	tenuistriatus,	. .	. .	. .	. .	*	. .	. .
Entomoconchus	Scouleri,	. .	. .	. .	. .	*	. .	*
Bairdia	curtus,	. .	. .	*	. .	. .	. .	. .
Cythere	arcuata,	. .	. .	*	. .	. .	. .	. .
,,	bituberculata,	. .	. .	*	. .	. .	. .	. .
,,	cornuta,	. .	. .	*	. .	. .	. .	. .
,,	costata,	. .	. .	*	. .	. .	. .	. .
,,	elongata,	. .	. .	*	. .	. .	. .	. .
,,	excavata,	. .	. .	*	. .	. .	. .	. .
,,	gibberula,	. .	. .	. .	. .	. .	*	. .
,,	Hibbertii,	. .	*	. .	. .	. .	. .	. .
,,	impressa,	. .	. .	*	. .	. .	. .	. .
,,	inflata,	. .	. .	. .	. .	*	. .	. .
,,	inornata,	. .	. .	*	. .	. .	. .	. .
,,	oblonga,	. .	. .	*	. .	. .	. .	. .
,,	orbicularis,	. .	. .	. .	*	. .	. .	. .
,,	pusilla,	. .	. .	. .	. .	. .	*	. .
,,	scutulum,	. .	. .	. .	. .	. .	*	. .
,,	subrecta,	. .	*	. .	. .	. .	. .	. .
,,	trituberculata,	. .	. .	*	. .	. .	. .	. .
Tubicola.			*	*	*	. .	*	. .
Annulosa.			*	*	*	. .	*	. .
Annelida.			*	*	*	. .	*	. .
Serpula	compressa,	. .	. .	. .	. .	. .	*	. .
,,	hexicarinata,	. .	. .	. .	. .	. .	*	. .
,,	parallela,	. .	. .	. .	. .	. .	*	. .
,,	scalaria,	. .	. .	. .	*	. .	. .	. .
Spirorbis	caperatus,	. .	. .	. .	*	. .	. .	. .
,,	globosus,	. .	*	. .	. .	. .	*	. .
,,	intermedius,	. .	. .	*	. .	. .	. .	. .
,,	minutus,	. .	. .	*	. .	. .	. .	. .
,,	omphalodes, ?	. .	. .	*	. .	. .	. .	. .
Spiroglyphus	marginatus,	. .	. .	. .	*	. .	. .	. .

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sands Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp, or Mid. Li.	Upper Li.
Serpulites	carbonarius,						*	
"	membranaceus,				*			
Sabella	antiqua,				*			
Nematoneura.		*	*	*	*	*	*	*
Echinodermata.		*	*	*	*	*	*	*
Palæchinus	elegans,				*			
"	ellipticus,					*		
"	gigas,			*	*			
"	Königii,			*			*	
"	sphæricus,							
Echinocrinus	elegans,				*			
"	glabrispina,				*		*	
"	triserialis,		*					
"	Urii,			*	*		*	*
"	vetustus,				*	*		
Adelocrinus	histrix,				*			
Pentremites	Derbiensis,							*
"	ellipticus,							*
"	florealis,							
Platycrinus	contractus,	*						
"	expansus,						*	
"	gigas,				*			
"	granulatus,				*			
"	interscapularis,				*			
"	laciniatus,				*		*	
"	lævis,				*			
"	ornatus,				*			
"	punctatus,				*			
"	rugosus,					*		
"	similis,				*			
"	triacontadactylus,				*			
"	tuberculatus,				*			
Poteriocrinus	gracilis,				*			
"	impressus,					*		
Taxocrinus	macrodactylus,				*			
"	polydactylus,						*	
Cyathocrinus	ellipticus,				*		*	
"	geometricus,				*			
"	inequidactylus,				*			
"	macrocheirus,			*				
"	megastylus,				*			
"	ornatus,				*			
"	pinnatus, ?				*	*	*	
"	planus,						*	
"	tuberculatus,				*			
"	variabilis,			*	*		*	*
Rhodocrinus (Gilbertsocrinus)	abnormis,					*		

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp or Mid. Li.	Upper Li.
Rhodocrinus	verus,	..	..	..	*	..	..	..
Actinocrinus	amphora,	..	..	..	..	*	..	..
"	constrictus,	..	..	..	..	..	..	*
"	costus,	..	..	..	..	..	..	*
"	Gilbertsoni,	..	..	..	*	..	..	..
"	polydactylus,	..	..	..	*	*	..	..
"	pusillus,	..	..	..	*	..	..	..
"	tenuistriatus,	..	..	*	*	..	*	..
"	tessellatus,	..	..	..	*	..	..	..
"	triacontadactylus,	..	..	..	*	*	..	*
Atocrinus	Milleri,	..	..	..	*	..	..	..
Acrita.		*	*	*	*	*	*	*
Zoophyta.		*	*	*	*	*	*	*
Amplexus	nodulosus,	..	..	..	*	..	..	..
"	Sowerbii,	..	..	..	*	*	..	..
"	tortuosus,	..	..	..	*	*	..	*
Turbinolopsis	bina, ?	..	..	*	*	..	..	..
"	Celtica,	..	..	..	*	..	..	..
"	pauciradialis,	..	..	..	*	..	..	..
"	pluriradialis,	..	..	..	*	..	..	..
Turbinolia	expansa,	..	..	..	..	*	..	..
"	fungites,	..	*	*	*	*	*	*
Siphonophyllia	cylindrica,	..	*	..	*	*	*	..
Astræa	aranea,	..	..	..	..	*	..	..
"	crenularis,	..	..	..	..	*	..	..
"	irregularis,	..	..	..	*	..	..	..
"	pentagona,	..	*	..	..	..	..	..
Lithostrotion	striatum,	..	*	..	..	*	..	*
Lithodendron	affine,	..	..	..	*	*	*	*
"	cæspitosum,	..	..	..	*	*	..	*
"	irregulare,	..	..	..	..	*	..	..
"	panciradialis,	..	..	..	..	*	..	..
"	sexdecimale,	..	..	..	*	..	..	..
"	sociale,	..	..	..	..	*	*	..
Syringopora	bifurcata,	..	..	..	*	..	..	..
"	catenata,	..	..	..	*	*	..	..
"	geniculata,	..	..	..	*	*	..	..
"	laxa,	..	*	*	..	..	..	*
"	ramulosa,	..	..	*	*	..	..	..
Aulopora	campanulata,	..	..	..	*	..	..	..
"	gigas,	..	..	..	..	*	..	..
Manon	cribrosum, ?	..	..	*	*	..	..	..
Astreopora	antiqua,	..	..	..	*	..	..	..
Dictyophyllia	antiqua,	..	..	..	*	..	..	..
Pleurodictyum	problematicum?	..	..	..	*	..	..	..
Favosites	capillaris,	..	..	..	..	*	..	..
"	fibrosa,	..	..	..	*	..	..	..
"	Gothlandica,	..	..	..	..	*	..	..

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp, or Mid. Li.	Upper Li.
Favosites?	megastoma,				*	*	*	
„ ?	parasitica,					*		
„	polymorpha,				*			
„	septosa,		*					*
„	serialis,				*			
„	spongites,				*	*	*	*
„ (Michelinia)	tenuisepta,				*	*	*	
„	tumida,				*			*
Stromatopora	concentrica,				*			
„	polymorpha,					*		
„	sublitis,					*		
Verticillopora	abnormis, ?				*		*	
„	dubia, ?					*		
Flustra	palmata,						*	
Berenicea	megastoma,				*			
Orbiculites	antiquus,				*			
Millepora	gracilis,				*		*	
„	interporosa,				*			
„ (Pustulopora)	oculata,	*			*		*	
„	rhombifera,				*			
„	similis,	*			*			
„ (Pustulopora)	spicularis,				*			
Tragos	semicirculare,							*
Gorgonia	assimilis,				*			
„	Lonsdaleiana,					*		
„	zic-zac,		*					
Jania	antiqua,				*			
„	bacillaria,				*			
„	crassa,				*	*	*	
Vincularia	dichotoma,					*		*
„	megastoma,							*
„	parallela,				*			*
„	raricosta,							*
Glauconome	bipinnata,				*		*	*
„	gracilis,					*		*
„	grandis,					*		
„	pluma,				*	*	*	*
„	pulcherrima,							*
Ptylopora	macropora,				*			
„	pluma,				*			
Fenestella	antiqua,			*	*	*	*	
„	carinata,				*			
„	crassa,					*		*
„	ejuncida,							*
„	flabellata,			*		*		
„	formosa,				*			*
„	frutex,							*
„	hemispherica,					*		

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y.Sands. Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp. or Mid. Li.	Upper Li.
Fenestella	laxa, . . .	. .	. .	. .	*	. .	. .	*
"	membranacea, .	. .	. .	. .	. .	*	. .	. .
"	Morrisii, . .	. .	. .	. .	. .	*	. .	. .
"	multiporata, .	. .	. .	. .	*	. .	. .	*
"	nodulosa, . .	. .	. .	. .	*	. .	*	*
"	oculata, . . .	. .	. .	. .	*	. .	. .	. .
"	plebeia, . . .	. .	. .	. .	*	*	. .	. .
"	polyporata, .	. .	. .	. .	. .	. .	*	*
"	quadradecimalis, . . .	. .	. .	. .	. .	. .	. .	*
"	regularis, . .	. .	. .	. .	*	. .	. .	. .
"	reticularis, . .	. .	. .	. .	*	*	*	. .
"	tenuifila, . .	. .	. .	*	*	*	*	*
"	undulata, . .	. .	*	*	*	*	*	*
"	varicosa, . .	. .	. .	. .	. .	. .	. .	*
Hemitrypa	Hibernica, .	. .	. .	. .	. .	*	*	*
Ichthyorachis	Newenhami, .	. .	. .	. .	. .	*	. .	. .
Polypora	dendroidea, .	. .	. .	. .	*	. .	. .	. .
"	marginata, .	. .	. .	. .	. .	. .	. .	*
"	papillata, . .	. .	. .	. .	. .	. .	. .	*
"	verrucosa, . .	. .	. .	. .	. .	. .	. .	*
Retepora	prisca, . . .	. .	. .	. .	*	*	. .	. .
"	undata, . . .	. .	. .	. .	*	*	. .	. .
Lower Carboniferous Plants.		*	. .	*	*	. .	. .	. .
Fucoides and Ferns, new, . .		*	. .	*	*	. .	. .	. .
Lepidodendron, new, . . .		. .	. .	. .	*	. .	. .	. .
Cyclostigma	new, . . .	*	. .	. .	. .	. .	. .	. .
Sphenopteris	linearis, . .	. .	. .	*	. .	. .	. .	. .
"	Hibernica, . .	*	. .	. .	. .	. .	. .	. .
Sternbergia	approximata, .	. .	. .	*	. .	. .	. .	. .
Stigmaria	ficoidea, . .	*	. .	. .	. .	. .	. .	. .
Fishes.		. .	*	*	*	*	*	. .
Palæoniscus	sp., ...	. .	. .	*	. .	. .	. .	. .
Amblypterus	sp., ...	. .	. .	*	. .	. .	. .	. .
Psammodus	cornutus, ? . .	. .	*	. .	*	*	*	. .
"	porosus, . .	. .	*	. .	*	. .	*	*
"	rugosus, . .	. .	*	. .	. .	. .	. .	. .
Helodus	sp., ...	. .	*	. .	. .	. .	. .	. .
"	mamillaris, .	. .	*	. .	. .	*	. .	. .
"	planus, . . .	. .	. .	*	. .	. .	. .	. .
"	turgidus, . .	. .	*	. .	. .	. .	. .	. .
Chomatodus	sp., ...	. .	*	. .	. .	. .	. .	. .
Cochliodus	sp., ...	. .	. .	. .	*	*	. .	. .
"	contortus, . .	. .	. .	. .	. .	*	. .	
"	gracilis, . .	. .	. .	. .	. .	*	. .	. .
"	magnus, . .	. .	*	. .	. .	*	*	. .

Names of Fossils.		Yellow Sandstone Group.				Limestone Group.		
Genera.	Species.	Y. Sand. Proper.	Ar. Li.	Ar. Sh.	Carb. Sl.	Lower Li.	Calp. or Mid. Li.	Upper Li.
Cladodus	,, ?	. .	●	. .	. .	●	. .	. .
,,	mirabilis,	. .	. .	●	. .	. .	. .	. .
Petalodus	Hastingsiæ,	. .	●	. .	. .	●	. .	. .
,,	lævissimus,	. .	●	. .	. .	. .	. .	. .
,, (palataltritor)	radicans,	. .	●	. .	. .	●	. .	. .
,,	sagittatus,	. .	●	. .	. .	. .	. .	. .
Ctenacanthus*	sp.,	. .	. .	●	. .	●	. .	. .
Asteroptychius	ornatus,	. .	. .	. .	. .	●	. .	. .
Oracanthus	Milleri,	. .	. .	●	. .	. .	. .	. .
Onchus	sp.,	. .	. .	. .	. .	●	. .	. .
Pœcilodus	sp.,	. .	. .	●	. .	. .	. .	. .
,,	Jonesi,	. .	●	. .	. .	. .	. .	. .
,,	sublævis,	. .	●	. .	. .	●	. .	. .
,,	transversus,	. .	●	. .	. .	●	. .	. .
Gyracanthus	obliquus,	. .	. .	●	. .	. .	. .	. .
,,	new ?	. .	. .	●	. .	. .	. .	. .
,,	tuberculatus,	. .	. .	●	. .	. .	. .	. .
,,	spines,	. .	. .	●	. .	. .	. .	. .
Holoptychius	sp.,	. .	. .	●	. .	. .	. .	. .
,,	Portlocki,	. .	. .	●	. .	. .	. .	. .
Phyllolepis	sp.,	. .	. .	●	. .	. .	. .	. .
Chelyophorus	Griffithii,	. .	. .	●	. .	. .	. .	. .
Isodus	leptognathus,	. .	. .	●	. .	. .	. .	. .
Psammosteus	granulatus,	. .	. .	●	. .	. .	. .	. .
,,	vermicularis,	. .	. .	●	. .	. .	. .	. .

THE FOLLOWING FOSSILS ARE DESCRIBED IN MY SYNOPSIS, THOUGH NOT CONTAINED IN THE CABINETS.

Genera.	Species.	Genera.	Species.
Orthoceras	Steinhaueri.	Bellerophon	Wenlockensis ?
,,	sulcatulum.	Euphemus ?	globatus.
Trigonoceras	paradoxicum.	,,	orbiculus.
Goniatites	Browni.	Conularia	quadrisulcata.
,,	crenistria.	Macrocheilus	sigmilineus.
,,	sphæricus.	,,	tricinctus.
,,	spiralis.	Loxonema	turrita.
,,	vittiger.	Littorina	pusilla.
Clymenia	plurisepta.	Euomphalus	bifrons.
Temnocheilus	bistrialis.	Pleurotomaria	clathrata.
Nautilus	goniolobus.	,,	Helicinoides.

Genera.	Species.	Genera.	Species.
Pleurotomaria	lævis.	Spirifera	bicarinata.
Murchisonia	sulcata.	"	convoluta.
Sanguinolites	liratus.	"	costata.
Lutraria	elongata.	"	extensa.
Pullastra	antiqua.	"	furcata.
"	elegans.	"	fusiformis.*
"	parallela.	"	mesomala.
Sedgwickia	corrugata.	"	pulchella.
Axinus	orbicularis.	"	transiens.
Nucula	delta.	Martinia	mesoloba.
"	linearis.	"	protensa.
Modiola	angusta.	Brachythyris	hemisphærica.
"	scalaris.	"	linguifera.
Lanistes	rugosus.	Atrypa	canalis ?
Inoceramus	auriculatus.	"	sublobata.
Posidonia	complanata.	"	virgoides.
"	sp.	Astacus ?	Phillipsii.
Meleagrina	alternata.	Griffithides	granuliferus.
"	echinata.	"	longiceps.
Pterinea	desquamata.	"	longispinus.
"	intermedia.	Phillipsia	Macoyii.
Avicula	bicostata.	Dithyrocaris	orbicularis.
Lingula	marginata.	Daphnia	primæva.
"	parallela.	Bairdia	gracilis.
Anomia	antiqua.	Cythere	amygdalina.
Pecten	cognatus.	"	sp.
"	comptus.	"	spinigera.
"	exiguus.	Palæchinus	sphæricus.
"	inornatus.	Echinocrinus	Munsterianus ?
"	leiotis.	Platycrinus	elongatus.
"	Meleagrinoides.	Cyathocrinus	conicus.
"	orbiculatus.	Actinocrinus	globosus.
Producta	comoides.	"	lævis.
"	spinulosa.	Phillipsocrinus	caryocrinoidea.
"	subaculeata.	Lithodendron	coarctatum.
Leptagonia	depressa.	Caunopora	placenta.
Leptæna	gibberula.*	Ceriopora	distans.
Orthis	compressa ?	Ptylopora	flustriformis.
"	orbicularis.	Hemitrypa	oculata.

* Type of sub-genus Fusella includes S. bicarinata and S. rhomboidea.

ARRANGEMENT OF THE FOREGOING FOSSILS UNDER THEIR RESPECTIVE LOCALITIES, POST-TOWNS, AND COUNTIES.

County Antrim.

BALLYCASTLE,

Vicinity of.

Pecten flabellulum.
Orthoceras cylindraceum.
Cycloceras annulare.
Bellerophon reticulatus.
Euphemus Urii.
Nucula attenuata.
Producta Edelburgensis.
,, Martini.
,, scabricula.
,, Scotica.
Leptæna Hardrensis.
Cyrtia semicircularis.
Reticularia reticulata.
Favosites tumida.

County Armagh.

ARMAGH.

Annahugh.

Bellerophon apertus.
,, hiulcus.

Vicinity of.

Bellerophon apertus.
Macrocheilus parallelus.
Naticopsis plicistria.
Elenchus subulatus.
Sanguinolites tumidus.
Producta elegans.
,, sulcata.
Cyrtia senilis.
Martinia oblata.
,, plebeia.
Athyris expansa.
Atrypa hastata.
Actinocrinus triacontadactylus.
Astræa crenularis.
Syringopora geniculata.
Favosites capillaris.

Drummanbeg.

Cladodus mirabilis.

Drummanmore.

Bellerophon apertus.
Producta punctata.
Sanguinolites sulcatus.
Plants.

Farmacaffy or Redbarn.

Pecten cælatus.
Psammodus porosus.
Helodus
,, turgidus.
Chomatodus
Cochliodus magnus.
Cladodus
Petalodus lævissimus.
,, radicans (palatal tritor).
,, sagittatus.
Petalodus Jonesi.
,, sublævis.
,, transversus.

Kilmore.

Naticopsis elongata.
Producta hemisphærica.
Syringopora laxa.

COUNTY ARMAGH, *continued*.

New Road.

Bellorophon cornu-arietis.
Euomphalus rotundatus.
Favosites septosus.
Pecten flaxuosus.

Tullyard.

Martinia plebeia.
Lithostrotion striatum.
Pecten ellipticus.

LOUGHGALL.

Ballygasey.

Phillipsia Jonesii.
Lithodendron sociale.
Helodus mammillaris.
Cochliodus contortus.
Cochliodus magnus.
Petalodus Hastingsiæ.
,, radicans (palatal tritor).
Ctenacanthus.
Asteroptychius ornatus.
Onchus.
Pæcilodus transversus.

TYNAN.

College Hall.

Naticopsis plicistria.
Platyschisma cirroides
Cladodus.

Enagh.

Fenestella carinata.
Petalodus Hastingsiæ.

COUNTY CARLOW.

OLD LEIGHLIN.

Vicinity of.

Producta aculeata.
,, costellata.
,, punctata.
,, quincuncialis.
Leptæna Hardrensis.
Orthis filiaria.
Spirifera minima.
Brachythyris exarata.
,, planicostata.

Raheendoran.

Lithostrotion striatum.
Lithodendron cæspitosum.
Favosites septosus.

LEIGHLIN-BRIDGE.

Bannaghagole.

Producta latissima.
Orthis filiaria.
Reticularia reticulata.
Brachythyris planicostata.
Lithostrotion striatum.

COUNTY CAVAN.

BALLYCONNELL.

Vicinity of.

Pecten granulosus.
Lithodendron affine.

Swanlinbar.

Turbinolia fungites.

Pulgulim or Swanlinbar.

Lithodendron sociale.

CAVAN.

Kilmore.

Pecten fallax.

Swellan.

Naticopsis plicistria.
Orthis papilionacea.
Favosites spongites.

County Cavan, *continued*.

KILLESHANDRA.

Townparks.

Temnocheilus porcatus.
Nucula cylindrica.
Modiola concinna.
Pecten Murchisoni.
Producta mesoloba.
,, quincuncialis.
Orthis papilionacea.
,, resupinata.
Echinocrinus Urii.
Polypora dendroides.

STRADONE.

Countenan.

Euomphalus acutus.
Pecten ellipticus.
,, granulosus.

Laragh.

Producta spinosa.

VIRGINIA.

Clonkeiffy.

Spirifera minima.

County Clare.

CLARE.

Meelick Chapel.

Glauconome grandis.

Derrybryan.

Spirifera calcarata.

TULLA.

Moymore.

Euomphalus tabulatus.

County Cork.

BALLEA.

Killingly.

Fenestella antiqua.

BANTRY.

Blackball Head.

Fenestella antiqua.
Plants.

Gurteenroe.

Fenestella antiqua.

Reendonoughan.

Spirifera disjuncta.

BUTTEVANT.

Ballybeg.

Nautilus cyclostomus.

CASTLEMARTYR.

Castlerichard.

Temnocheilus furcatus.

CARRIGALINE.

Shanbally.

Spirifera grandæva.
Atrypa prisca.
Orthis arachnoidea.
,, tenuistriata.
Spirifera inornata.

Vicinity of.

Naticopsis dubia.
Corbis cancellata.
Producta ovalis.
Orthis crenistria.
Spirifera gigantea.
Martinia elliptica.

COUNTY CORK, *continued.*

CHARLEVILLE.

Annagh.

Orthoceras ovale.
Discites mutabilis.

CORK.

Bantyre.

Cucullæa arguta.

Blackrock.

Discites discors.
Modiola patula.
Cyrtia simplex.

Vicinity of.

Plants.
Cyrtoceras tuberculum.
Goniatites discus.
,, obtusus.
Discites planotergatus.
Platyschisma zonites.
Edmondia compressa.
Cardiomorpha ventricosa.
Inoceramus lævissimus.
Cyrtia dorsata.
Martinia rhomboidalis.
Atrypa anisodonta.

Cove or Queenstown.

Loxoceras incomitatum.

Derrylief.

Dolabra attenuata.

Dunally.

Orthis interlineata.
Spirifera calcarata.

Little Island.

Orthoceras striatum.
Loxoceras Breynii.
,, laterale.
Campyloceras unguis.
Goniatites ovatus.
Discites subsulcatus.
,, sulcatus.
Temnocheilus coronatus.
,, multicarinatus.
Nautilus cyclostomus.
,, dorsalis.
Macrocheilus rectilineus.
Euomphalus acutus.
,, pentangulatus.
,, rotundatus.
,, tabulatus.
Pleurotomaria Hainesii.
,, lenticula.
Acroculia vetusta.
Psammobia decussata.
Cardium orbiculare.
Cardiomorpha oblonga.
Pecten clathratus.
,, deornatus.
,, ellipticus.
,, fallax.
,, granosus.
,, intercostatus.
,, planicostatus.
,, Sedgwickii.
,, semistriatus.
Producta concinna.
,, fimbriata.
,, fragaria.
,, hemisphærica.
,, mesoloba.
,, quincuncialis.
,, Scotica.
,, setosa.
Leptagonia plicatilis.
Orthis connivens.
,, resuspinata.
Spirifera calcarata.
,, choristites.
,, disjuncta.
,, rotundata.
Cyrtia cuspidata.
Martinia glabra.
,, obtusa.
,, plebeia.
Reticularia imbricata.
,, lineata.
Athyris glabristria.

COUNTY CORK, *continued.*

Actinoconchus paradoxus.
Atrypa acuminata.
,, cordiformis.
,, platyloba.
,, sacculus.
,, triangularis.
Dythyrocaris tenuistriatus.
Entomoconchus Scouleri.
Amplexus Sowerbii.
Turbinolia expansa.
,, fungites.
Glauconome gracilis.
Fenestella hemisphærica.
,, Morrisii.
,, plebeia.
Hemitrypa Hibernica.

Middleton.

Orthoceras striatum.
Temnocheilus biangulatus.
Nautilus cyclostomus.
Pleurorhynchus Hibernicus.
Leptagonia analoga.
,, multirugata.

Rinniskiddy.

Spirifera grandæva.
Cyrtia nuda.
Atrypa striatula.
Cyathocrinus pinnatus.

DONERAILE.

Castlecreagh.

Orthoceras attenuatum.
Goniatites Listeri.
Bellerophon hiulcus.

Vicinity of.

Orthoceras pyramidale.
Loxoceras laterale.
Cycloceras lineolatum.
Goniatites obtusus.

Fortwilliam.

Temnocheilus globatus.

Streamhill.

Loxoceras Breynii.
Naticopsis Phillipsii.

KILDORRERY.

Tankardstown.

Orthoceras cylindraceum.
Goniatites truncatus.
Temnocheilus multicarinatus.
Bellerophon apertus.
Loxonema sulculosa.
Euomphalus calyx.
,, pentangulatus.
Pleurorhynchus Hibernicus.
Pecten Murchisoni.
Producta mesoloba.
,, pustulosa.
,, sulcata.
Orthis crenistria.
Spirifera rhomboidea.
,, striata.
Reticularia lineata.
Fenestella tenuifila.

KILWORTH.

Arraglin Bridge.

Cypricardia alata.
,, cylindrica.
,, oblonga.
,, quadrata.
,, sinuata.

KINSALE.

Old Head of.

Goniatites striolatus.
Posidonia lateralis.
Avicula, sp. new.

YOUGHAL.

Whiting Bay.

Orthis Bechei.
Spirifera disjuncta.

County Donegal.

BALLINTRA.

Greaghs.

Pecten granulosus.
Producta pectinoides.
Fenestella tenuifila.
,, undulata.

Lisnapaste.

Orthoceras filiferum.
Discites tetragonus.
Euomphalus serpens.
Pleurotomaria tornatilis.
Fissurella elongata.
Sanguinolites Iridinoides.
Venus tenuistriata.
Pullastra ovalis.
Pleurorhynchus trigonalis.
Cypricardia rhombea.
Nucula birostrata.
,, carinata.
,, Phillipsii.
,, rectangularis.
,, unilateralis.
Byssoarca lanceolata.
Modiola amygdalina.
,, divisa.
Meleagrina rigida.
Pecten Hardingii.
,, incrassatus.
,, mundus.
,, Murchisoni.
,, semicircularis.
,, serratus.
,, Sowerbii.
,, undulatus.
Orbicula trigonalis.
Producta antiquata.
,, concinna.
,, hemisphærica.
,, longispina.
,, margaritacea.
,, membranacea.
,, pustulosa.
,, scabricula.
,, setosa.
Leptagonia analoga.
Leptæna convoluta.
,, Dalmaniana.
,, Hardrensis.
,, plicata.
,, sericea.
,, sordida.
Orthis circularis.
,, granulosa.
,, interlineata.
Spirifera calcarata.
,, clathrata.
,, crispa.
,, grandæva.
,, rhomboidea.
,, Urii.
Cyrtia cuspidata.
,, simplex.
Martinia plebeia.
,, strigocephaloides.
Brachythyris duplicicosta.
Athyris decussata.
,, hispida.
,, squamosa.
Atrypa reniformis.
Phillipsia Colei.
Serpula scalaris.
Cyathocrinus ellipticus.
,, megastylus.
,, pinnatus.
Actinocrinus tenuistriatus.
Turbinolia fungites.
Pleurodictyum problematicum.
Millepora gracilis.
,, interporosa.
,, rhombifera.
Jania bacillaria.
Glauconome pluma.
Fenestella regularis.
Retepora undata.

BALLYSHANNON.

Ardloughil.

Orthis crenistria.

COUNTY DONEGAL, *continued.*

Abbeybay or Abbeylands.

Pleurorhyncus giganteus.
Pecten cingendus.
Producta concinna.
„ longispina.
„ pectinoides.
Leptagonia analoga.
Orthis filiaria.
„ semicircularis.
Spirifera gigantea.
„ speciosa.
Cyrtia laminosa.
Athyris decussata.
Atrypa pleurodon.
Serpula parallela.
Jania crassa.

BUNDORAN.

Ballintrillick.

Sanguinolites angustatus.
„ Iridinoides.
„ plicatus.
Lucina antiqua.
Cypricardia subtruncata.
Nucula cylindrica.
„ Phillipsii.
Avicula squamosa.
Lima obliqua.
Pecten depilis.
„ ellipticus.
„ granulosus.
„ interstitialis.
„ plicatus.
„ polytrichus.
„ Sowerbii.
„ tabulatus.
Producta corrugata.
„ elegans.
„ fimbriata.
„ hemisphærica.
„ lobata.
„ margaritacea.
„ pectinoides.
„ pugilis.
„ Scotica.
Producta setosa.
„ spinosa.
„ sulcata.
Leptagonia analoga.
Leptæna convoluta.
„ Hardrensis.
Orthis crenistria.
„ quadrata.
„ radialis.
„ resupinata.
„ tenuistriata.
Spirifera bisulcata.
„ crispa.
„ ostiolata.
„ speciosa.
„ Urii.
Cyrtia laminosa.
Martinia glabra.
„ plebeia.
Reticularia imbricata.
Brachythyris duplicicosta.
„ exarata.
„ integricosta.
„ pinguis.
„ planata.
Atrypa fallax.
„ hastata.
„ sulcirostris.
Seminula pentahedra.
Griffithides obsoletus.
Phillipsia gemmulifera.
Cythere gibberula.
„ scutulum.
Serpula parallela.
Echinocrinus Urii.
Taxocrinus polydactylus.
Cyathocrinus variabilis.
Lithodendron sociale.
Favosites ? spongites.
Verticillopora abnormis. ?
Millepora gracilis.
„ oculata.
Fenestella antiqua.
„ nodulosa.
„ polyporata.
„ tenuifila.
„ undulata.

COUNTY DONEGAL, *continued.*

BUNDORAN, *continued.*

Hemitrypa Hibernica.

Pecten megalotis.
Producta pugilis.
,, setosa.
Cyathocrinus variabilis.
Fenestella multiporata.
,, nodulosa.
,, tenuifila.
Hemitrypa Hibernica.

Vicinity of.

Orthoceras attenuatum.
Loxoceras laterale.
Cyrtoceras tuberculatum.
Loxonema sulculosa.
Euomphalus pentangulatus.
Patella sinuosa.
Ungulina antiqua.
Amphidesma subtruncatum.
Pleurorhynchus minax.
Dolabra rectangularis.
Nucula cylindrica.
Byssoarca reticulata.
Avicula flabellulum.
,, laminosa.
Pecten megalotis.
,, plano-clathratus.
,, sclerotis.
,, Sowerbii.
,, variabilis.
Orbicula nitida.
Producta fimbriata.
,, longispina.
,, margaritacea.
,, ovalis.
,, punctata.
,, quincuncialis.
,, scabricula.
,, setosa.
,, sulcata.
Leptæna crassistria.
,, Hardrensis.
,, sordida.
,, volva.
Orthis crenistria.
,, papilionacea.
,, parallela.
,, resupinata.
Spirifera attenuata.
,, calcarata.
,, gigantea.
,, octoplicata.
,, ostiolata.
,, speciosa.
Cyrtia distans.
,, subconica.
Reticularia microgemma.
Brachythyris integricosta.
,, planata.
Athyris fimbriata.
,, glabristria.
Serpula ? compressa.
,, hexicarinata.
Echinocrinus glabrispina.
,, Urii.
Cyathocrinus pinnatus. ?
Actinocrinus tenuistriatus.
Favosites ? megastoma.
Glauconome bipinnata.
,, pluma.
Fenestella reticularis.

Finner.

Euomphalus calyx.
,, crotalostomus.
Pleurorhynchus giganteus.
,, minax.
Byssoarca clathrata.
Producta concinna.
,, longispina.
,, margaritacea.
,, Martini.
,, setosa.
Leptæna crassistria.
,, Hardensis.
Orthis filiaria.
Spirifera attenuata.
,, gigantea.
Cyrtia laminosa.
Martinia plebeia.

COUNTY DONEGAL, *continued.*

BUNDORAN, *continued.*

Brachythyris concentrica.
Athyris expansa.
Serpula? parallela.
Palæchinus Königii.
Platycrinus expansus.
,, laciniatus.
Cyathocrinus ellipticus.
Favosites? tenuisepta.
Glauconome pluma.
Psammodus porosus.
Cochliodus magnus.

DONEGAL.

Vicinity of.

Pleurotomaria conica.
Producta ovalis.
Spirifera gigantea.
Athyris depressa.

Doorin.

Pleurotomaria canaliculata.
Dolabra equilateralis.
Pecten ellipticus.
,, rugulosus.
Producta caperata.
Orthis granulosa.
Spirifera speciosa.
Cyrtia cuspidata.
Reticularia lineata.
Athyris depressa.

Inver.

Athyris planosulcata.
Atrypa pugnus.

Laghy.

Athyris glabristria.

Lough Esk.

Athyris glabristria.
Echinocrinus Urii.

Stridagh Point.

Leptagonia analoga.
Orthis radialis.
Cyrtia laminosa.

Tinnycahill.

Naticopsis spirata.
Sanguinolites angustatus.
Cyrtia distans.
Syringopora geniculata.

DUNKINEELY.

Aighan Bridge.

Plants.

Ballybodonnell.

Cucullæa tenuistria.
Leptæna multidentata.
Martinia elliptica.
Turbinolia fungites.

Bruckless Chapel.

Plants.

Bruckless.

Clymenia sagittalis.
Discites tetragonus.
Macrocheilus curvilineus.
,, ovalis.
Loxonema tumida.
Euomphalus acutus.
,, calyx.
,, pentangulatus.
,, serpens.
,, tabulatus.
Pleurotomaria canaliculata.
Elenchus antiquus.
Acroculia sigmoidalis.
Patella mucronata.
Sanguinolites angustatus.
,, discors.
,, plicatus.
Pullastra elliptica.
Astarte gibbosa.
Cyprina Egertoni.
Pleurorhynchus minax.
Cypricardia alata.
Axinus deltoideus.
Nucula clavata.
,, gibbosa.
,, Phillipsii.

COUNTY DONEGAL, *continued.*

DUNKINEELY, *continued.*

Crenella acutirostris.
Modiola lingualis.
Pteronites angustatus.
Avicula laminosa.
Lima planicostata.
Pecten ellipticus.
,, interstitialis.
,, macrotis.
,, polytrichus.
,, semicircularis.
,, Sowerbii.
,, spinulosus.
Producta caperata.
,, concinna.
,, elegans.
,, lobata.
,, margaritacea.
,, scabricula.
,, setosa.
,, spinosa.
,, sulcata.
Leptæna Hardrensis.
,, lata. ?
,, sordida.
Orthis filiaria.
,, granulosa.
,, resupinata.
,, semicircularis.
,, sulcata.
Spirifera attenuata.
,, disjuncta.
,, ostiolata.
,, speciosa.
Brachythyris duplicicosta.
,, planicostata.
Athyris concentrica.
,, decussata.
Atrypa fallax.
,, hastata.
,, juvenis.
,, laticosta.
,, pleurodon.
,, radialis.
,, sulcirostris.
Cyathocrinus variabilis.
Actinocrinus tenuistriatus.
Turbinolopsis bina. ?
Turbinolia fungites.
Syringopora laxa.
Manon cibrosum. ?
Fenestella antiqua.
,, flabellata.
,, multiporata.
,, tenuifila.
,, undulata.
Plants.

Killaghtee.

Bellerophon hiulcus.
Inoceramus vetustus.
Brachythyris duplicicosta.

MacSwyne's Bay.

Stigmaria fucoides (roots and portion of trunk).
Sigillaria.
Ferns.

Rahan's Bay.

Euomphalus pentangulatus.
Dolabra securiformis.
Avicula angusta.
Pecten fallax.
Orbicula quadrata.
Producta corrugata.
,, sulcata.
Orthis crenistria.
,, latissima.
,, papilionacea.
Spirifera octoplicata.
,, speciosa.
Cyrtia distans.
Palæchinus gigas.
,, Konigii.
Echinocrinus Urii.
Cyathocrinus macrocheirus.
Actinocrinus tenuistriatus.
Syringopora ramulosa.

St. John's Point.

Discites sulcatus.
Loxonema constricta.

County Donegal, *continued.*

DUNKINEELY, *continued.*

Loxonema sulculosa.
Euomphalus acutus.
Pleurotomaria canaliculata.
Pleurorhynchus giganteus.
Producta latissima.
,, pectinoides.
,, pugilis.
Leptæna multidentata.
Orthis arcuata.
,, crenistria.
,, latissima.
,, papilionacea.
,, parallela.
Orthis resupinata.
Cyrtia cuspidata.
,, simplex.
Athyris decussata.
,, hispida.
Echinocrinus Urii.
Platycrinus punctata.
Lithodendron sexdecimale.
Syringopora catenata.
,, geniculata.
,, ramulosa.
Jania antiqua.
,, crassa.
Favosites Gothlandica.

County Down.

COMBER.

Castle Espie.

Actinoceras giganteum.
,, pyramidatum.
Naticopsis elongata.
Producta gigantea.
,, laxispina.
,, Scotica.
Orthis cylindrica.

HOLLYWOOD.

Cultra.

Kellia gregaria.
Modiola Macadamiid.
Cythere bituberculata.
,, cornuta.
,, costata.
,, elongata.
,, inornata.
,, trituberculata.
Spirorbis intermedius.
,, omphalodes.
Fern stem.
Sternbergia approximata.
Plants.
Palæoniscus Sp.
Holoptychius Portlockii.
Ctenacanthus.

County Dublin.

BALBRIGGAN.

Courtlough (Man-of-War).

Posidonia Becheri.
,, similis.
Leptæna papyracea.

Flemingstown.

Pecten mundus.

Salmon (Man-of-War).

Avicula lunulata.
Producta corrugata.
,, laxispina.
,, pectinoides.
Leptagonia plicatilis.
Spirifera trigonalis.
Atrypa acuminata.

COUNTY DUBLIN, *continued.*

CLONTARF.

Vicinity of.

Plants.

HOWTH.

Vicinity of.

Goniatites Listeri.
Euomphalus acutus.
Venerupis cingulatus.
Avicula laminosa.
,, lunulata.
Pecten arenosus.
,, concentrico-striatus.
,, ellipticus.
,, gibbosus.
,, granosus.
,, Sowerbii.
Producta aculeata.
,, antiquata.
,, fragaria.
,, lirata.
,, margaritacea.
,, rugata.
,, spinosa.
Orthis filiaria.
Spirifera speciosa.
,, Urii.
Martinia obtusa.
Athyris decussata.
Atrypa lachryma.
,, sacculus.
,, sulcirostris.
,, ventilabrum.
Seminula pisum.
,, rhomboidea.
Phillipsia gemmulifera.
,, truncatula.
Platycrinus rugosus.
Favosites megastoma.
Vincularia dichotoma.
Fenestella membranacea.
,, reticularis.
,, tenuifila.
,, undulata.
Retepora undata.

Poulscadden.

Loxonema tumida.
Sanguinolites angustatus.
Pullastra bistriata.
Pleurorhynchus aliformis.
,, armatus.
,, minax.
Pecten megalotis.
Producta concinna.
,, fragaria.
,, granulosa.
,, longispina.
,, pustulosa.
,, rugata. ?
,, scabricula.
,, setosa.
Leptæna volva.
Orthis crenistria.
,, filiaria.
,, granulosa.
,, interlineata.
,, longisulcata.
,, parallela.
,, resupinata.
,, semicircularis.
Spirifera attenuata.
,, disjuncta.
,, rudis.
Cyrtia distans.
,, laminosa.
Reticularia microgemma.
Athyris concentrica.
,, decussata.
,, fimbriata.
Atrypa fallax.
,, hastata.
Phillipsia gemmulifera.
Platycrinus interscapularis.
Cyathocrinus ellipticus.
Rhodocrinus verus.
Turbinolia fungites.
Siphonophyllia cylindrica.
Lithodendron sexdecimale.
Syringopora bifurcata.
Favosites megastoma.
,, spongites.

County Dublin, *continued.*

HOWTH, *continued.*

Favosites tenuisepta.
Verticillopora abnormis.
Millepora oculata.
,, rhombifera.
,, spicularis.
Glauconome bipinnata.
,, pluma.
Ptylopora macropora.
,, pluma.
Fenestella nodulosa.
,, spongites.
,, tenuifila.
,, undulata.
Anomia antiqua.
Cochliodus.

MALAHIDE.

Vicinity of.

Orthoceras cylindraceum.
Euomphalus æqualis.
,, rotundatus.
,, tabulatus.
Acroculia triloba.
Pleurorhynchus aliformis.
,, fusiformis.
Pecten fallax.
Producta caperata.
,, concinna.
,, longispina.
,, pugilis.
,, punctata.
,, quincuncialis.
,, scabricula.
,, setosa.
,, spinosa.
,, sulcata.
Leptagonia analoga.
Orthis crenistria.
,, filiaria.
Spirifera attenuata.
,, calcarata.
,, crispa.
,, disjuncta.
,, ostiolata.
,, rotundata.
,, speciosa.
Cyrtia cuspidata.
,, distans.
,, laminosa.
,, semicircularis.
,, simplex.
Martinia elliptica.
Reticularia microgemma.
Brachythyris duplicicosta.
,, pinguis.
Athyris concentrica.
,, decussata.
,, depressa.
,, glabristria.
Atrypa flexistria.
,, lachryma.
,, pleurodon.
,, proava.
,, radialis.
,, sacculus.
,, ventilabrum.
Echinocrinus Urii.
Platycrinus gigas.
Cyathocrinus inequidactylus.
,, ornatus.
,, variabilis.
Actinocrinus Gilbertsoni.
,, pusillus.
,, triacontadactylus.
Amplexus Sowerbii.
Turbinolia fungites.
Syringopora geniculata.
,, ramulosa.
Favosites megastoma.
,, serialis.
,, spongites.
,, tumida.
Stromatopora concentrica.
Syringopora geniculata.
Psammodus porosus.
Verticillopora abnormis.
Millepora interporosa.
Ptylopora pluma.
Fenestella antiqua.
,, carinata.
,, formosa.
,, tenuifila.
,, undulata.

COUNTY DUBLIN, *continued.*

OLDTOWN.

Vicinity of.

Turritella tennuistria.

RUSH.

Curkeen.

Orthoceras cylindraceum.
Bellerophon tenuifascia.
Loxonema polygyra.
Euomphalus æqualis.
Platyschisma helicoides.
Reticularia lineata.
Stromatopora subtilis.

Loughshinny.

Posidonia Becheri.
„ membranacea.
„ lateralis.
Plants.

Vicinity of.

Producta granulosa.
„ hemisphærica.
Leptagonia plicatilis.
Leptæna convoluta.
Reticularia lineata.
Brachythyris pinguis.
Atrypa juvenis.
Griffithides obsoletus.
Orthoceras cinctum.
Posidonia Becheri.
„ costata.
„ lateralis.
„ membranacea.
„ tuberculata.
Pecten plicatus.
Producta aculeata.
„ concinna.
„ membranacea.
„ rugata.
Atrypa semisulcata.
Millepora oculata.

SKERRIES.

Baldongan.

Posidonia membranacea.

Ballykea.

Euomphalus acutus.
„ æqualis.
„ pentangulatus.
Pleurorhynchus minax.
Producta Edelburgensis.
„ sulcata.

Drumlattery.

Macrocheilus rectilineus.

Lane.

Naticopsis Phillipsii.

Milverton.

Pleurotomaria concentrica.
Producta corrugata.
„ pustulosa.
Martinia oblata.
Brachythyris planicostata.
Athyris expansa.
„ obtusa.

St. Doolagh's.

Meleagrina tesselata.
Pecten granosus.
Producta scabricula.
Leptæna volva.
Martinia phalæna.
Brachythyris planata.
Atrypa flexistria.
„ pugnus.
Serpulites membranaceus.
Cyathocrinus megastylus.
„ pinnatus.
Millepora similis.
Retepora prisca.
Producta flexistria.
Brachythyris pinguis.

SWORDS.

Rathbale.

Athyris concentrica.

County Fermanagh.

BOA ISLAND.

Ardshankill.

Axinus centralis.
Dolabra orbicularis.
Modiola megaloba.
Pteronites ventricosus.

CHURCHILL.

Vicinity of.

Spirifera minima.
Athyris globularis.

EDERNY.

Drum.

Euomphalus crotalostomus.

Drumkeeran.

Producta Scotica.

Vicinity of.

Orthis papilionacea.

ENNISKILLEN.

Belmore Mountain.

Cyathocrinus planus.
Producta concinna.
Turbinolia fungites.
Favosites tumida.
Glauconome pluma.
Fenestella laxa.

Carrickreagh.

Euomphalus crotalostomus.

Carrowtremal.

Meleagrina radiata.
Pecten interstitialis.
Orthis resupinata.

Cornacarrow.

Producta antiquata.
,, elegans.
,, quincuncialis.
,, scabricula.
Leptagonia analoga.
Orthis gibbera.
,, resupinata.
Spirifera attenuata.
,, rotundata.
Martinia glabra.
,, oblata.
Amplexus Sowerbii.
Aulopora gigas.

Derryvullan.

Platycrinus rugosus.
Actinocrinus amphora.

Knockninny.

Meleagrina tessellata.
Pecten arenosus.
,, interstitialis.
Producta punctata.
,, sulcata.
Spirifera minima.
Atrypa flexistria.
,, sulcirostris.
Pentremites Derbiensis.
Hemitrypa Hibernica.

Lough Erne.

Turbinolia fungites.

Ring.

Discites sulcatus.
Euomphalus pentangulatus.
Pleurotomaria concentrica.
Sanguinolites arcuatus.
Leptagonia analoga.
Spirifera attenuata.
Reticularia imbricata.
Naticopsis canaliculata.

COUNTY FERMANAGH, *continued.*

KESH.

Carrickoughter.

Loxonema sulcatula.
Inoceramus pernoides.

Vicinity of.

Producta latissima.

Drumcurren.

Avicula Verneuillii.

River Banagh, Drumcurren.

Sedgwickia attenuata.
Pæcilodus, sp.
Sphenopteris linearis.

Drumgowna.

Pleurotomaria altavittata.

Tullanaguiggy.

Producta tortilis.

TEMPO.

Leam, Moneyburn River.

Murchisonia Larcomi.
Cypricardia socialis.
Lingula squamiformis.

COUNTY GALWAY.

GORT.

Cregganore.

Producta prælonga.
,, setosa.
Orthis arcuata.
,, crenistria.
Spirifera crispa.
,, inornata.
Atrypa fallax.
Atrypa juvenis.
,, pleurodon.
,, radialis.
Platycrinus contractus.
Millepora oculata.
,, similis.

PORTUMNA.

Vicinity of.

Goniatites Listeri.

COUNTY KERRY.

KILLARNEY.

Brickeen Bridge.

Pecten arachnoideus.
Plants.

CASTLE ISLAND.

Vicinity of.

Pleurorhynchus Hibernicus.

Currens.

Producta caperata.
Leptagonia analoga.
Leptagonia nodulosa.
Orthis comata.
,, crenistria.
,, interlineata.
,, tenuistriata.
Spirifera megaloba.
Cyrtia cuspidata.
,, distans.
Athyris decussata.
Atrypa fallax.
Phillipsia truncatula.
Cyathocrinus geometricus.
,, variabilis.
Turbinolopsis bina.

County Kerry, *continued*.

CASTLE ISLAND, *continued*.

Vicinity of.

Turbinolopsis pauciradialis.
,, pluriradialis.
Fenestella antiqua.
,, formosa.
,, reticularis.

TRALEE.

Castleogary.

Spirifera inornata.

Ballymacelligott.

Siphonaria Konicki.

New Canal.

Patella scutiformis.

County Kildare.

CLANE.

Millicent.

Orthoceras pyramidale.
Loxoceras Breynii.
,, laterale.
Poterioceras fusiforme.
,, ventricosum.
Actinoceras giganteum.
Goniatites fasciculatus.
,, latus.
,, Listeri.
,, obtusus.
Discites costellatus.
,, discors.
,, latidorsatus.
,, subsulcatus.
Temnocheilus biangulatus.
,, cariniferus.
,, costalis.
,, multicarinatus.
,, sulciferus.
Nautilus dorsalis.
Bellerophon lævis.
,, obsoletus.
,, tenuifascia.
Macrocheilus acutus.
,, curvilineus.
,, imbricatus.
Loxonema constricta.
,, sulculosa.
Turritella megaspira.
Naticopsis elongata.
,, Phillipsii.
Euomphalus acutus.
Euomphalus calyx.
,, neglectus.
,, pentangulatus.
Platyschisma helicoides.
Pleurotomaria decussata.
,, filosa.
,, Griffithii.
,, multicarinata.
Trochella prisca.
Acroculia carinata.
,, vetusta.
Patella sinuosa.
Umbrella lævigata.
Sanguinolites arcuatus.
,, tumidus.
Lutraria prisca.
Cyprina Egertoni.
Cardiomorpha axiniformis.
,, corrugata.
,, oblonga.
Pleurorhynchus Hibernicus.
,, minax.
Leptodomus senilis.
Venerupis obsoletus.
,, scalaris.
Amphidesma subtruncatum.
Byssoarca obtusa.
,, reticulata.
Lithodomus dactyloides.
Mytilus Flemingi.
Inoceramus orbicularis.
,, pernoides.
Pteronites latus.
Avicula lævigata.
,, laminosa.

County Kildare, *continued.*

CLANE, *continued.*

Avicula lunulata.
,, recta.
Lima lævigata.
Pecten arenosus.
,, concentrico-striatus.
,, dissimilis.
,, ellipticus.
,, elongatus.
,, fallax.
,, filatus.
,, Forbesii.
,, granosus.
,, hians.
,, Sowerbii.
Crania vesiculosa.
Producta antiquata.
,, flexistria.
,, granulosa.
,, intermedia.
,, laciniata.
,, margaritacea.
,, mesoloba.
,, pectinoides.
,, producta.
,, rugata.
,, setosa.
Leptæna ?
,, serrata.
,, volva.
Orthis crenistria.
,, divaricata.
,, papilionacea.
,, resupinata.
,, tuberculata.
Spirifera attenuata.
,, bisulcata.
,, decemcostata.
,, ornithorhyncha.
,, princeps.
,, rotundata.
Cyrtia cuspidata.
,, distans.
,, linguifera.
Martinia elliptica.
,, glabra.
Martinia plebeia.
Barchythyris pinguis.
Athyris glabristria.
Actinoconchus paradoxus.
Atrypa bifera.
,, cordiformis.
,, ferita.
,, hastata.
,, pugnus.
,, reniformis.
,, sacculus.
Seminula pentahedra.
Griffithides globiceps.
Phillipsia discors.
,, gemmulifera.
,, quadriserialis.
Eutomoconchus Scouleri.
Palæchinus ellipticus.
Peteriocrinus impressus.
Rhodocrinus abnormis.
Actinocrinus polydactylus.
,, triacontadactylus.
Amplexus Sowerbii.
Vincularia dichotoma.
Fenestella crassa.
,, membranacea.
Retepora undata.
Cochliodus gracilis.

MAYNOOTH.

Paget Priory.

Goniatites Gibsoni.

RATHANGAN.

Boston.

Producta concinna.

RATHCOOLE.

Ardclough.

Orthoceras ovale.
Loxoceras laterale.
Temnocheilus cariniferus.
,, multicarinatus.
,, sulciferus.

County Kildare, *continued*.

RATHCOOLE, *continued*.

Bellerophon apertus.
,, hiulcus.
Naticopsis Phillipsii.
Euomphalus pentangulatus.
Pleurotomaria Griffithii.
Producta antiquata.
Producta fragaria.
,, pectinoides.
Orthis papilionacea.
Spirifera rhomboidea.
,, rotundata.
Atrypa pugnus.
Platycrinus rugosus.
Actinocrinus triacontadactylus.

County Leitrim.

CLOONE.

Drumconny.

Lepidodendron new.

ENNISKILLEN.

Black Lion.

Orthoceras attenuatum.
,, cylindraceum.
Campyloceras arcuatum.
Goniatites excavatus.
,, striolatus.
Discites sulcatus.
Nautilus cyclostomus.
Turritella suturalis.
Naticopsis spirata.
Murchisonia quadricarinata.
Lutraria prisca.
Cypricardia cuneata.
Arca cancellata.
Cucullæa arguta.
Byssoarca costellata.
,, reticulata.
Inoceramus vetustus.
Meleagrina quadrata.
,, radiata.
Pteronites semisulcatus.
Lima lævigata.
Pecten asperulus.
,, gibbosus.
,, interstitialis.
,, Jonesii.
,, megalotis.
Producta concinna.
Producta corrugata.
,, granulosa.
,, laxispina.
,, mesoloba.
,, pectinoidea.
,, pustulosa.
,, rugata.
,, setosa.
,, spinosa.
,, sulcata.
Leptagonia analoga.
Orthis crenistria.
Spirifera attenuata.
,, bisulcata.
,, minima.
,, rhomboidea.
Cyrtia linguifera.
Martinia plebeia.
Reticularia imbricata.
Athyris fimbriata.
Actinoconchus paradoxus.
Atrypa hastata.
,, pleurodon.
,, pugnus.
,, sacculus.
,, ventilabrum.
Seminula rhomboidea.
Entomoconchus Scouleri.
Pentremites florealis.
Amplexus tortuosus.
Favosites spongites.
Vincularia dichotoma.
Glauconome bipinnata.
,, pluma.
,, pulcherrima.

County Leitrim, *continued*.

ENNISKILLEN, *continued*.

Fenestella crassa.
,, ejuncida.
,, laxa.
,, nodulosa.
,, polyporata.
,, quadradecimalis.
,, tenuifila.
,, undulata.
,, varicosa.
Hemitrypa Hibernica.
Polypora marginata.
,, papillata.
,, verucosa.

DRUMOD (MOHILL).

Bleankillew.

Plants.

MANORHAMILTON.

Vicinity of.

Acroculia vetusta.
Avicula gibbosa.
Producta aculeata.
,, elegans.
,, laxispina.
Leptagonia plicatilis.
Spirifera gigantea.
,, speciosa.
Echinocrinus Urii.
Pentremites Derbiensis.
,, ellipticus.
Actinocrinus constrictus.
,, costus.
,, triacontadactylus.
Tragos semicirculare.
Dirinus Bucklandi.
Sanguinolites curtus.
,, Iridinoides.
Byssoarca semicostata.
Pteronites sulcatus.
Lima semisulcata.
Pecten megalotis.
,, segregatus.
Producta antiquata.
,, granulosa.
,, pugilis.
Orthis arcuata.
Spirifera Urii.
Athyris decussata.
Atrypa ventilabrum.
Serpulites carbonarius.
Siphonophyllia cylindrica.
Lithodendron affine.
Flustra palmata.

MOHILL.

Drumod.

Pleurorhynchus nodulosus.

Fearnaght Lough River.

Malleus orbicularis.

Tullyoran.

Naticopsis neritoides.
Producta concinna.
,, latissima.
,, quincuncialis.
Spirifera gigantea.
Martinia obtusa.

Mohill, Vicinity of.

Avicula cycloptera.
Pecten plicatus.
,, quinquelineatus.
,, scalaris.
,, Sowerbii.
Producta corrugata.
,, margaritacea.
,, pugilis.
,, quincuncialis.
,, scabricula.
,, setosa.
,, sulcata.
Leptæna Hardrensis.
Orthis parallela.

County Leitrim, *continued*.

MOHILL, *continued*.

Spirifera gigantea.
,, ostiolata.
Cyrtia semicircularis.
Reticularia imbricata.
,, microgemma.
Brachythyris integricosta.
Athyris glabristria.
,, squamosa.
Atrypa laticosta.
Cyathocrinus megastylus.
Favosites tenuisepta.
Millepora interporosa.
Vincularia parallela.
Retepora undata.

County Limerick.

KILMALLOCK.

Chicken Hill.

Loxonema impendens.
Euomphalus anguis.

Vicinity of.

Loxoceras distans.
Goniatites sphæroidalis.
Temnocheilus pinguis.
Acroculia triloba.
Sanguinolites contortus.
Mactra incrassata.
Cyprina Egertoni.
Ichthyorachis Newenhami.
Fenestella flabellata.

County Londonderry.

DRAPERSTOWN.

Cullion.

Loxonema polygyra.
Venus centralis.
Cypricardia concinna.
,, minima.
Sedgwickia bullata.
,, globosa.
Pecten simplex.
Monotis æqualis.
Cythere oblonga.
,, pusilla.

Dromard.

Macrocheilus fimbriatus.
Murchisonia elongata.
Axinus nuculoides.
Nucula stilla.
Cythere arcuata.
,, impressa.
Plants.
Fern stem, new.

Mormeal.

Palæoniscus, sp.

Moyheeland.

Palæoniscus, sp.
Amblypterus, sp.
Gyracanthus, sp.?
,, new.
,, tuberculatus.
Holoptychius Portlocki.
Phyllolepis?
Plants.

MAGHERA.

Ballynure.

Amblypterus, sp.
Holoptychius Portlockii.

Fallagloon.

Fern stems.
Holoptychius Portlockii.

MAGHERAFELT.

Slievegallion.

Spirifera bisulcata.
Turbinolia fungites.

County Longford.

BALLYMAHON.

Mullawornia.

Goniatites striolatus.
Pecten plicatus.
Producta aculeata.
,, fimbriata.
Reticularia imbricata.
Actinoconchus paradoxus.
Amplexus tortuosus.

Shrule.

Cycloceras lævigatum

Tirlecken.

Loxoceras laterale.
Temnocheilus biangulatus.
,, cariniferus.
,, crenatus.
,, multicarinatus.
Bellerophon tangentialis.
Loxonema tumida.
Turritella tenuistria.
Euomphalus pentangulatus.
,, tabulatus.
Brachythyris pinguis.

DRUMLISH.

Monaduff.

Orthoceras attenuatum.
Nucula oblonga.
Ctenacanthus.
Oracanthus Milleri.
Holoptychius Portlocki.
Plants.

GRANARD,

Vicinity of.

Temnocheilus biangulatus.
Euomphalus catillus.
,, tabulatus.
Producta quincuncialis.
Orthis papilionacea.
Spirifera bisulcata.
,, calcarata.
Cyrtia linguifera.
Atrypa sacculus.
Bairdia curtus.
Gorgonia Zic-Zac.

LANESBOROUGH.

Ratholine.

Orthoceras cylindraceum.
Producta quincuncialis.
,, setosa.
Leptagonia plicatilis.
Spirifera bisulcata.
Cyrtia linguifera.
Martinia oblata.
,, obtusa.
Brachythyris exarata.
,, pinguis.
Athyris glabristria.
,, pugnus.
Lithodendron irregulare.
Lithostrotion striatum.

LONGFORD.

Carrickboy.

Pleurorhynchus inflatus.

Kilcommock.

Nautilus dorsalis.
Naticopsis Phillipsii.
Fenestella membranacea.

Vicinity of.

Temnocheilus multicarinatus.
Orthis crenistria.

SHRULE.

Tirlecken.

Temnocheilus crenatus.
Euomphalus tabulatus.

County Louth.

CARLINGFORD.

Vicinity of.

Belleropbon apertus.
" costatus.
" tangentialis.
Siphonophyllia cylindrica.

DUNDALK.

Knockagh.

Actinoconchus paradoxus.

County Mayo.

BALLYCASTLE.

Ballinglen.

Euomphalus elongatus.
Modiola subparallela.
Lima concinna.
Atrypa angularis.
Helodus mammillaris.

Bunatrahir Bay.

Sanguinolites plicatus.
Ferns.

Carrowcor.

Stigmaria ficoides.
Sigillaria.
Lepidodendron.
Producta hemisphærica.
Atrypa Gregaria.

Doonadoba.

Orthoceras laterale.
Bellerophon apertus.
Murchisonia elongata.
Loxonema constricta.
Euomphalus acutus.
" pentangulatus.
Producta hemisphærica.
Orthis crenistria.
Spirifera attenuata.
Palæchinus elegans.
Turbinolia fungites.
Favosites megastoma.
Fenestella antiqua.
Psammodus porosus.
Cladodus mirabilis.

Kilbride.

Orthoceras attenuatum.
Temnocheilus tuberculatus.
Sanguinolites sulcatus.
Pinna mutica.
Pecten interstitialis.
Producta aculeata.
" fimbriata.
Orthis parallela.
Spirifera calcarata.
Athyris globularis.
Atrypa gregaria.
Griffithides obsoletus.
Phillipsia Colei.
Turbinolia fungites.
Fenestella undulata.

BANGOR.

Larganmore.

Cypricardia tumida.
Axinus axiniformis.
" carbonarius.
Nucula leiorhynchus.
Pecten duplicicosta.
Atrypa indentata.
" virgo.
Cythere Hibbertii.
" subrecta.
Astræa pentagona.

KILLALA.

Crosspatrick.

Goniatites intercostalis.
Discites sulcatus.
Pullastra crassistria.

County Mayo, *continued.*

KILLALA, *continued.*

Vicinity of.

Turbo spirata.
Sanguinolites tricostatus.
Mactra ovata.

Kilcummin, Killala Bay.

Macrocheilus canaliculatus.
Atrypa compta.
Lacuna antiqua.
Ferns and Fucoides.

Killogunra.

Avicula informis.
Pecten concavus.

Killybrone.

Stromatopora concentrica.
Fenestella plebeia.

Mullaghfarry.

Discites sulcatus.

Townplots.

Anatina attenuata.
,, deltoidea.
Cypricardia modiolaris.
Pecten conoideus.
,, depilis.
,, pera.

LACKAN BAY.

Kilcummin.

Sanguinolites transversus.
Axinus carbonarius.
Helodus planus.

County Meath.

DRUMCONDRA.

Ardagh.

Bellerophon apertus.
,, tangentialis.
,, tenuifascia.
Euomphalus acutus.
,, pileopsideus.
,, rotundatus.
Leptodomus senilis.
Inoceramus vetustus.
Avicula laminosa.
Lima alternata.
,, prisca.
Pecten ovatus.
,, semistriatus.
Producta Edelburgensis.
,, fimbriata.
,, laxispina.
,, Martini.
,, mesoloba.
,, pustulosa.
,, striata.
,, sublævis.
,, sulcata.
Leptagonia plicatilis.
Orthis crenistria.
,, radialis.
Spirifera rhomboidea.
,, trigonalis.
Martinia elliptica.
,, oblata.
,, plebeia.
Reticularia imbricata.
,, reticulata.
Brachythyris duplicicosta.
,, integricosta.
Athyris expansa.
,, globularis.
,, squamosa.
,, excavata.
,, pugnus.
,, sacculus.
,, ventilabrum.
Echinocrinus vetustus.
Turbinolia fungites.

Ballyhoe Lake.

Producta hemisphærica.

COUNTY MAYO, *continued.*

DULEEK.

Mullaghfin.

Euomphalus rotundatus.
Producta Martini.
Spirifera striata.
„ trigonalis.
Martinia decora.
„ oblata.
„ plebeia.
„ symmetrica.
Brachythyris duplicicosta.
„ planicostata.
Atrypa bifera.
„ pugnus.

MOYNALTY.

Horath.

Bellerophon apertus.
Turritella tenuistria.
Naticopsis spirata.
Euomphalus catillus.
Cyprina Egertoni.
Pleurorhynchus aliformis.
Spirifera ostiolata.
Turritella suturalis.

NAVAN.

Walterstown.

Posidonia membranacea.

NOBBER.

Balsitric.

Euomphalus marginatus.
Pleurorhynchus giganteus.
Cypricardia cuneata.

Cregg.

Loxoceras laterale.
Goniatites mutabilis.
„ obtusus.
Euphemus Urii.
Cucullæa tenuistria.
Pecten Murchisoni.
Producta Edelburgensis.
„ maxima.
„ pectinoides.
„ sulcata.
Orthis papilionacea.
Spirifera attenuata.
„ crispa.
„ octoplicata.
„ trigonalis.
Martinia oblata.
Atrypa pleurodon.
„ sulcirostris.
Actinocrinus triacontadactylus.
Lithodendron affine.
Favosites spongites.

Cruisetown.

Posidonia Becheri.

Rathgillen.

Orthoceras attenuatum.
„ cinctum.
„ ovale.
Cucullæa tenuistria.
Producta Martini.
„ pectinoides.
„ sulcata.
Leptagonia analoga.
Spirifera rhomboidea.
Athyris planosulcata.

SKREEN.

Walterstown.

Atrypa semisulcata.

SLANE.

Vicinity of.

Cyrtia semicircularis.

TRIM.

Laracor.

Temnocheilus biangulatus.
Macrocheilus acutus.
Turritella tenuistria.
Producta mesoloba.
Seminula pisum.
Cythere inflata.
Gorgonia Lonsdaleiana.
Glauconome pluma.

County Monaghan.

CARRICKMACROSS.

Clonturk.

Pleurorhynchus trigonalis.
Spirifera ostiolata.

Mullylusty.

Pleurorhynchus giganteus.

EMYVALE.

Killyrean, Upper.

Goniatites intercostalis.

Tonyshanderry.

Pecten flexuosus.

MONAGHAN.

Dundonagh.

Producta hemisphærica.
,, Scotica.

Vicinity of.

Spirifera ostiolata.
Producta Scotica.
Orthis Kellii.

Leek.

Cardium orbiculare.

Mullaghliss.

Producta Scotica.

Queen's County.

MARYBOROUGH.

Cloghran.

Spirifera attenuata.

County Roscommon.

BALLINASLOE.

Moore.

Cardiomorpha oblonga.
Producta muricata.
Spirifera attenuata.
Athyris squamosa.
Amplexus Sowerbii.

BOYLE.

Vicinity of.

Producta concinna.
,, spinosa.
Spirifera rotundata.
Athyris fimbriata.
Favosites parasitica.

Cleen.

Turbinolia fungites.
Favosites tenuisepta.

Drumdoe.

Producta scabricula.
Athyris expansa.
,, sulcirostris.

Grangemore.

Producta spinosa.
Orthis filiaria.
Favosites spongites.

Lisardrea.

Producta Martini.
Leptæna Hardrensis.
Orthis filiaria.

Termon.

Reticularia striatella.
Leptæna hardrensis.
Orthis papilionacea.
Turbinolia fungites.
Favosites megastoma.

County Roscommon, *continued.*

CARRICK-ON-SHANNON.

Killukin.

Producta elegans.
" granulosa.
Leptagonia analoga.
Favosites spongites.

CASTLEREAGH.

Kiltullagh.

Bellerophon apertus.
Naticopsis elongata.
Producta corrugata.
" gigantea.
" scabricula.
Orthis papilionacea.
Atrypa acuminata.
Lithodendron affine.

KEADUE.

Cartronaglogh.

Producta latissima.
" sulcata.
Brachythyris pinguis.
Griffithides obsoletus.

ROSCOMMON.

Rathmoyle House.

Loxonema constricta.
Euomphalus crotalostomus.
Cyrtia linguifera.
Reticularia imbricata.
Atrypa hastata.

Vicinity of.

Lithodendron sociale.

Strokestown.

Euomphalus cristatus.

TULSK.

Toberory.

Loxonema brevis.
Acroculia canaliculata.

County Sligo.

EASKY.

Ballymeeny.

Astarte quadrata.

Bunowna.

Pinna flexicostata.
Cythere orbicularis.
Astræa irregularis.

Carrowmably.

Taxocrinus polydactylus.

SLIGO.

Carnly.

Atrypa sulcirostris.

TEMPLEBOY OR TOBBERCURRY.

Carrowmacrory.

Pandora clavata.
Sedgwickia gigantea.
Mytilus comptus.

TOBBERCURRY.

Magheramore.

Astræa aranea.
Lithodendron pauciradialis.

County Tipperary.

CLOGHEEN.

Newcastle.

Producta Martini.
Cyrtia cuspidata.

KNOCKLOFTY.

Vicinity of.

Cyathocrinus variabilis.
Turbinolopsis Celtica.

NENAGH.

Vicinity of.

Goniatites sphæroidalis.

PORTUMNA.

Carrigahorig.

Loxoceras laterale.
Turritella suturalis.
Euomphalus pentangulatus.

County Tyrone.

AUGHER.

Fymore Todd.

Turritella tenuistria.
Atrypa radialis.

AUGHNACLOY.

Lismore.

Favosites megastoma?

BALLYGAWLEY.

Aunaghilla.

Orthis Kellii.

Faeglassagh.

Teredo? antiqua.

Knockonny.

Pecten Knockonniensis.

CASTLEDERG.

Edenasop.

Orthis crenistria.

Scraghy.

Producta Scotica.
Orthis papilionacea.
Siphonophyllia cylindrica.
Lithodendron cæspitosum.
Favosites megastoma?

CLOGHER.

Aghnaglogh.

Modiola Macadami.
Dithyrocaris Colei.
„ Scouleri.
Cythere excavata.
Spirorbis globosus.
„ minutus.

Ballymacan.

Spirorbis globosus.

Mullaghtinny.

Goniatites reticulatis.
Euomphalus quadratus.
Sanguinolites undatus.
Axinus axiniformis.
„ obliquus.
„ obovatus.
Dolabra gregaria.
Nucula longirostris.

COOKSTOWN.

Clare.

Pleurotomaria concentrica.
Acroculia angustata
Athyris glabristria.

Donaghrisk.

Platyschisma Jamesii.
Producta aurita.

COUNTY TYRONE, *continued.*

Kildress.

Atrypa triplex.
Phillipsia mucronata.
Sabella antiqua.

Cookstown.

Discites trochlea.
Bellerophon costatus.
Euphemus Urii.
Turritella suturalis.
Naticopsis plicistria.
Euomphalus rotundatus.
Platyschisma helicoides.
Pleurotomaria carinata.
Patella mucronata.
Dentalium inornatum.
Sanguinolites sulcatus.
Donax primigenius.
Nucula rectangularis.
Pinna flabelliformis.
Pecten cœlatus.
Producta aurita.
,, concinna.
,, elegans.
,, fimbriata.
,, Martini.
,, Scotica.
,, setosa.
Cyrtia cuspidata.
,, senilis.
Martinia plebeia.
Atrypa isorhyncha.
,, laticliva.
,, radialis.
,, virgo.
Phillipsia Kellii.
Astræa crenularis.
Lithodendron cæspitosum.
Lithostrotion striatum.
Verticillopora dubia.
Cochliodus.

DRUMQUIN.

Ardsallagh.

Syphonophyllia cylindrica.

Vicinity of.

Turritella acicula.
Sanguinolites Iridinoides.
Pullastra elliptica.
Nucula attenuata.
,, brevirostris.
Orthis papilionacea.

Drumscraw.

Loxoceras laterale.
Goniatites striatus.
Discites oxystomus.
Bellerophon apertus.
Producta concinna.
Athyris triloba.
Syringopora geniculata.

Laokagh.

Bellerophon apertus.
Loxonema pulcherrima.
Euomphalus tabulatus.
Patella scutiformis.
Sanguinolites angustatus.
,, plicatus.
Cypricardia rhombea.
Nucula gibbosa.
Producta hemisphærica.
,, lobata.
,, Martini.
,, punctata.
Athyris planosulcata.
Siphonophyllia cylindrica.
Lithodendron affine.
Favosites tenuisepta.
Jania crassa.
Glauconome pluma.

Magherenny.

Bellerophon cornu-arietis.

Meenacarighy.

Favosites megastoma.

COUNTY TYRONE, *continued.*

DUNGANNON.

Drumreagh.

Solenopsis minor.

Killymeal.

Sanguinolites radiatus.
Byssoarca obtusa.
Pteronites semisulcatus.
Lima alternata.
,, decussata.
Pecten æqualis.
,, cancellatulus.
,, concentrico-striatus.
,, ellipticus.
,, granosus.
,, intercostatus.
,, tripartitus.
Producta concinna.
,, gigantea.
,, latissima.
,, Martini.
Brachythyris planicostata.
Phillipsia cælata.
Syringopora laxa.
Favosites tumida.
Vincularia megastoma.
,, parallela.
,, raricosta.
Glauconome gracilis.
,, pluma.
Fenestella formosa.
,, frutex.
,, multiporata.
Polypora marginata.
,, papillata.

Mulnahunch.

Euomphalus tabulatus.

Roughan.

Sanguinolites Iridinoides.
Griffithides calcaratus.

FIVEMILETOWN,

Vicinity of.

Naticopsis plicistria.
Atrypa fallax.

Rahoran.

Avicula Thomsoni.
Pecten bellis.
,, consimilis.
,, irregularis.
Leptæna perlata.
Orthis caduca.
Atrypa nana (with Pecten consimilis).
Orbiculites antiquus.

LISBELLAW.

Killycloghy.

Phragmoceras flexistria.
Sanguinolites costellatus.
Pecten micropterus.
Echinocrinus triserialis.

OMAGH.

Dromore.

Producta Scotica.

STEWARTSTOWN.

Tumpher.

Astræa crenularis.

COUNTY WATERFORD.

ARDMORE.

Ardoe.

Leptæna plicata.
Spirifera aperturata.
Atrypa fallax.
Actinocrinus tenuistriatus.

Curragh.

Orthis arachnoidea.
,, parallela.
Cyrtia cuspidata.
Athyris decussata.
Atrypa striatula.

County Waterford, *continued.*

ARDMORE, *continued.*

Cyathocrinus geometricus.
Favosites fibrosa.

CLONMEL.

Kilnamack.

Leptagonia nodulosa.
Spirifera crispa.
,, disjuncta.
Cyrtia distans.
Atrypa fallax.
Fenestella tenuifila.

DUNGARVAN.

Ballinacourty.

Orthoceras cylindraceum.
,, ovale.
Loxoceras laterale.
Goniatites micronotus.
Temnocheilus biangulatus.
Naticopsis Phillipsii.
Cyrtia distans.
Glauconome antiqua.
,, crassa.
Retepora prisca.
,, undata.
Goniatites Gibsoni.
,, striolatus.
Pleurorhynchus aliformis.
Pecten arachnoideus.
Producta aculeata.
,, caperata.
,, interrupta.
,, membranacea.
,, rugata.
,, sulcata.
Leptagonia rugosa.
Leptæna convoluta.
,, sericea.
Orthis arcuata.
,, granulosa.
,, interlineata.
,, longisulcata.
Spirifera attenuata.
,, bisulcata.
,, octoplicata.
,, rhomboidea.
,, rudis.
Cyrtia laminosa.
Martinia phalæna.
Brachythyris integricosta.
,, ovalis.
,, pinguis.
Athyris concentrica.
,, glabristria.
Atrypa desquamata.
,, hastata.
,, insperata.
,, striatula.
Calymene granulata.
Adelocrinus histrix.
Platycrinus granulatus.
,, interscapularis.
,, similis.
,, tuberculatus.
Taxocrinus macrodactylus.
Cyathocrinus ellipticus.
,, geometricus.
,, pinnatus.
,, variabilis.
Actinocrinus polydactylus.
,, triacontadactylus.
Amplexus nodulosus.
,, Sowerbii.
Turbinolopsis Celtica.
,, pauciradialis.
Manon cibrosum ?
Pleurodictyum problematicum ?
Verticillopora abnormis ?
Millepora gracilis.
Gorgonia assimilis.
Glauconome bipinnata.
,, pluma.
Fenestella oculata.

Ballyduff.

Goniatites excavatus.
,, Listeri.

County Waterford, *continued.*

DUNGARVAN, *continued.*

Ballyduff, continued.

Goniatites obtusus.
,, ovatus.
Temnocheilus pinguis.
,, sulciferus.
Bellerophon apertus.
Naticopsis Phillipsii.
Pleurorhynchus minax.
Arca fimbriata.
Pecten dissimilis.
,, ellipticus.
,, fallax.
,, gibbosus.
,, plicatus.
,, Sowerbii.
Calceola sandalina.
Producta laciniata.
,, lirata.
,, pectinoides.
,, rugata.
Leptæna Hardrensis.
Orthis divaricata.
,, longisulcata.
Cyrtia cuspidata.
Brachythyris ovalis.
Cythere inflata.
Amplexus tortuosus.
Stromatepora polymorpha.

Vicinity of.

Temnocheilus tuberculatus.

Clonea.

Euomphalus serpens.
Pecten transversus.
Producta caperata.
,, fragaria.
,, prælonga.
Leptagonia analoga.
Leptæna plicata.
Orthis filiaria.
,, granulosa.
,, parallela.
,, semicircularis.
Spirifera aperturata.
Spirifera attenuata.
,, disjuncta.
,, ostiolata.
,, rotundata.
Cyrtia nuda.
Martinia decora.
,, glabra.
,, phalæna.
Athyris decussata.
,, globularis.
Atrypa desquamata.
,, insperata.
,, oblonga?
,, striatula.
Calymene lævis.
,, Latreillii.
Echinocrinus glabrispina.
Taxocrinus macrodactylus.
Cyathocrinus pinnatus?
,, variabilis.
Actinocrinus tenuistriatus.
,, tesselatus.
Amplexus nodulosus.
,, Sowerbii.
,, tortuosus.
Turbinolopsis Celtica.
Manon cribrosum?
Pleurodictyum problematicum.
Favosites fibrosa.
Verticillopora abnormis.
Millepora gracilis.
Fenestella laxa.

TALLOW.

Camphire.

Plants.

Janeville.

Plants.

Tallowbridge.

Sphenopteris Hibernica.
Lepidodendron Griffithii.
Cyclostigma, Stigmaria, &c.

Vale of the Bride.

Plants.

County Wexford.

FETHARD.

Hook Head.

Acroculia triloba.
,, tubifer.
,, vetusta.
Pleurorhynchus aliformis.
Pecten fallax.
Producta caperata.
,, corrugata.
,, pugilis.
,, pustulosa.
,, quincuncialis.
,, setosa.
Leptagonia nodulosa.
Leptæna convoluta.
,, Hardrensis.
Orthis crenistria.
,, interlineata.
,, parallela.
Spirifera attenuata.
,, bisulcata.
,, calcarata.
,, gigantea.
,, ostiolata.
,, rhomboidea.
,, speciosa.
Cyrtia cuspidata.
,, distans.
,, laminosa.
,, mesogonia.
,, semicircularis.
,, simplex.
Martinia plebeia.
Reticularia imbricata.
,, microgemma.
Brachythyris pinguis.
Athyris concentrica.
,, decussata.
,, depressa.
,, squamosa.
Atrypa fallax.
,, hastata.
Phillipsia truncatula.
Spirorbis caperatus.
Spiroglyphus marginatus.
Palæchinus elegans.
,, gigas.
Echinocrinus elegans.
,, glabrispina.
,, vetustus.
Platycrinus laciniatus.
,, lævis.
,, ornatus.
,, triacontadactylus.
Poteriocrinus gracilis.
Cyathocrinus tuberculatus.
Atocrinus Milleri.
Amplexus Sowerbii.
,, tortuosus.
Turbinolia fungites.
Siphonophyllia cylindrica.
Lithodendron sexdecimale.
Aulopora campanulata.
Astreopora antiqua.
Dictyophyllia antiqua.
Favosites polymorpha.
Berenicea megastoma.
Ptylopora pluma.
Polypora dendroides.
Acroculia tubifer.
Athyris squamosa.
Psammodus porosus.

Catalogue of the several Localities in Ireland where Mines or Metalliferous Indications have hitherto been discovered, arranged in Counties, according to their respective Post Towns.

Note.—The localities with an asterisk prefixed are situate in Igneous or Lower Sedimentary Rocks; the remainder occur for the most part in Limestone. Mines *now* or *formerly* worked are printed in Italics, but no opinion as to the relative or actual productiveness of any is intended to be offered; subdenominations of Mineral districts are grouped for convenience between brackets; when Mines have been recognized by other designations, these latter are added in parentheses. The numbers attached to the localities refer to the Ordnance Sheets which contain them. Several authorities and explanatory remarks are interspersed. Collieries are omitted, the Coal-fields being described in Sir Richard Griffith's Reports, and marked on his Geological Map of Ireland, from which the following localities were originally compiled, many years ago, for the use of the General Survey and Valuation of Ireland.

Though Metallic Lodes have not been discovered in the Counties of Carlow, Londonderry, and Westmeath, it is not improbable that such may occur.

Post Towns.	Localities and Counties.	No. of Ordnance Sheet.
	ANTRIM.	
Ballycastle, ...	Coal-field (Ballynagard, Torglass, Tornaroan, &c.), Clay-ironstone, and Hematite,	5 & 9
Carrickfergus, . . .	*Duncrue*, thick beds of Rocksalt, also Gypsum on Coast from Belfast, Northward, .	52
Larne, ...	*Dundressan, Iron,†	41
	ARMAGH.	
Belleek, ... *Drumnahoney Mines*, .	**Carrickgallogly*, Lead, — Griffith, MSS., Mines of Ireland, 1821, ...	25
	**Drumnahoney*, Lead, ...	25
Crossmaglen, ...	*Dorsy, Lead,—discovered by Joseph Backhouse, of London, Esq., ...	28
	*Tullyard, Lead, ...	30
	*Tullydonnell, Copper, ...	31
Keady, ...	*Aughnagurgan, Lead, ...	20
	**Clay*, Lead and Manganese, ...	19
	**Doohat or Crossreagh*, Lead,—communicated by William Conn, Esq., ...	19
	**Drummeland* (*Derrynoose*),—Lead, worked by the late Lord Farnham many years ago, ...	19
Middletown, ...	**Tamlaght*, Lead, ...	15
Newry, ...	*Drumbanagher (Church Glen), Lead, .	22
	**Kilmonaghan* (*Jerrets or Tuscan Pass*), Copper, ...	22
Newtownhamilton, .	**Ballintemple*, Lead, — communicated by Joseph Backhouse, Esq., ...	25
Pointzpass, ...	**Ballymore*, Lead,—exact position not ascertained, ...	18, &c.

† When the word Iron occurs alone, Magnetic, Specular, or other Ores (proper), of Iron are those intended; thus distinguishing them from the Clay-ironstone, a regular rock formation.

Post Towns.	Localities and Counties.	No. of Ordnance Sheet.
	CAVAN.	
Cavan, ...	*Farnham Demesne, Copper, ...	20
Cootehill, ...	* *Cornanurney* (*Wheal Burrowes*), Lead, .	22
Shercock, ...	*South East of, Lead, ...	29, &c.
Swanlinbar, ...	*Cuilcagh District*, Clay-ironstone,—Griffith's Coal Reports, ...	6
	CLARE.	
Ballyvaghan, . . .	Cappagh, Copper, Argentiferous Lead, and Manganese, ...	6
Feakle, ...	*Corrakyle, Copper, ...	20
	*Glendree, Lead, ...	19 & 27
	*Leaghort, Copper,—communicated by R. Purdy Allen, Esq., Sec. to the Mining Company of Ireland, ...	20 42
Newmarket-on-Fergus,	*Carrownakilly*, Argentiferous Lead, . .	34
Quin, ...	*Ballyhickey*, Argentiferous Lead, and Copper, with Zinc, ...	34
Castletown Mines, . .	{ *Castletown*, Lead, ...	34
	{ *Moyriesk*, Argentiferous Lead, ...	34
	Monanoe (*Kilbreckan*), Argentiferous Lead, and Antimony,—Kilbreckanite, . . .	34
Roadford, ...	*Crumlin*, Argentiferous Lead, ...	4
	Doolin, Argentiferous Lead, ...	8
Sixmilebridge, . . .	Rathlaheen South, Lead and Sulphur Ore,—communicated by R. W. Townsend, Esq.	51
Tomgraney, ...	* *Ballyhurly*, Lead, Griffith's MSS., Mines of Ireland, ...	29
Tulla, ...	Ballyvergin, Lead, Copper and Sulphur Ore,—communicated by R. W. Townsend, Esq.,	26
	Knockaphreagaun (*Crow Hill*), Argentiferous Lead, ...	34
	Milltown, Silver and Lead,—worked by the Bullion Mining Company, ...	35
	CORK.	
Ballydehob, ...	* *Ballycummisk*, Copper,—see Griffith's Report on Audley Mines, ...	140
	* *Cappaghglass* (*Cappagh*), Copper, . .	140
Audley Mines, . . .	* *Foilnamuck*, Copper, ...	140
	* *Horse Island*, Copper, Traces of Lead occur in the Gossans of all these mines, .	149
	* *Rossbrin*, Copper, ...	140
	* *Ballydehob*, Copper, worked by South Cork Mining Company, ...	140
	* *Boleagh*, Copper, ...	140
Ballydehob Mines, . .	* *Cooragurteen*, Copper, ...	140
	* *Kilcoe*, Copper, ...	140
	* *Skeaghanore*, Copper, ...	140
	* *Derreennalomane*, Copper, ...	131

Post Towns.	Localities and Counties.	No. of Ordnance Sheet.
	CORK, *continued.*	
Roaringwater Mines, .	*Kilkilleen, Copper and Lead, ...	140
	*Laheratanvally, Copper and Lead, . .	140
	*Leighcloon, Copper, ...	140
BANTRY, ...	**Carravilleen*, Copper, ...	129
	**Clashadoo* (*Four-Mile-Water*), Copper, .	130
	*Derreengreanagh, Copper and Sulphate of Barytes,—communicated by R. W. Townsend, Esq., ...	118
	**Glanalin*, Copper, ...	129
	**Gortavallig*, Copper, ...	138
Hollyhill Mines, . .	**Gortacloona*, Lead, ...	118
	**Hollyhill*, Copper, ...	118
	**Killeen*, Copper, ...	129
	**Killoveenoge*, Argentiferous Lead, . . .	117
	**Rooska, East*, Argentiferous Lead, . . .	117
CARRIGTOHILL, . . .	*Vicinity of*, Lead with Zinc,—Mr. Courtney's Estate, ...	75 & 76
CASTLETOWN-BEARHAVEN, ...	**Allihies*, Copper,—Griffith, MSS., . . .	114
Bearhaven Mines, . .	**Cahermeeleboe*, Copper, ...	127
	**Caminches*, Copper, ...	114
	**Cloan*, Copper, ...	114
	**Coom*, Copper, ...	114
	**Kealoge*, Copper, ...	114 & 127
	**Kilkinnikin, West*, Lead, ...	127
	*Killaconenagh, traces of Lead and Copper in several places, ...	115, 128, &c.
CASTLETOWNSEND, . .	*Cooscroneen, Copper,—communicated by R. W. Townsend, Esq., ...	142
	Rabbit Island (Squince), Antimony, Copper, and Lead, ...	142
CLONAKILTY, ...	**Duneen*, Lead, Copper, and Sulphate of Barytes,—worked chiefly for Barytes at present, ...	144
CORK, ...	*Rathpeacon, Copper (traces of Malachite),	63
CROOKHAVEN, . . .	*Altar, Copper, ...	148
	*Ballydivlin, Copper, ...	147
	*Ballyrisode, Copper,—communicated by R. W. Townsend, Esq., ...	147
	**Balteen*, Copper, ...	147
	**Carrigacat* (*Dhurode*), Copper and Auriferous Gossan, ...	147
Crookhaven Mines, .	**Boulysallagh* (*West Carbery*), Copper, Silver, and Lead, ...	147
	**Callaros*, Copper, ...	147
	**Cloghane* (*Mizen Head*), Copper, . . .	146
	**Crookhaven*, Copper,—worked by Crookhaven Mining Company, ...	147
	**Kilbarry*, Copper, ...	147
	**Mallavoge* (*Brown Head*), Copper,—property of Lord Charles Clinton, M. P., .	152
	**Spanish Cove* (*Kilmoe*), Copper and Argentiferous Lead, ...	147

Post Towns.	Localities and Counties.	No. of Ordnance Map.
	CORK, *continued.*	
	**Lackavaun*, Copper,	147
	*Toormore, Copper,	148
DUNMANWAY,	*Demesne, Mundic,	107 & 108
	*Derreens, Copper,—communicated by R. W. Townsend, Esq.,	107
Lackue Mines,	**Coom* (*Lackue Wood*), Copper,—property of John D'Arcy Evans, Esq.	107
	**Inchanadreen*, Copper,—communicated by Fitz-Lionel Fleming, Esq.,	107
GLENGARIFF,	**Esk Mountain*, Copper,	90
MILLSTREET,	**Vicinity of*, Copper,	89
NOHAVAL,	**Minane*, Lead,	99
Ringabella Mines,	**Ringabella*, Argentiferous Lead,	99
ROSSCARBERY,	**Aghatubrid*, Manganese and Copper,—Griffith, MSS.,	142
	*Derry, Copper,	143
Glandore Mines,	**Drom*, Copper,	142
	**Keamore*, Copper,	142
	**Kilfinnan*, Copper,	143
	**Rouryglen*, Manganese and Iron,	143
	*Gortagrenane, Copper,—communicated by R. W. Townsend, Esq.,	143
	*Little Island, Copper and Sulphate of Barytes,	143
SKIBBEREEN,	**Bawnishall*, Copper,	151
SKULL,	**Castlepoint*, Copper,	148
	**Castleisland*, Copper,	149
	**Coosheen*, Copper and Iron,	139 & 144
Coosheen Mines,	**Gortnamona*, Copper,	140
	**Long Island*, Copper,	148
	**Skull*, Copper,	148
	*Leamcon, Copper,—communicated by R. W. Townsend, Esq.,	148
	*Mountgabriel, Copper,	139
	DONEGAL.	
BALLYBOFEY,	**Welchtown*, Lead and Iron,	68
BALLYSHANNON,	*Abbey Island*, Argentiferous Lead with Zinc, and Copper,	107
	Abbeylands, Argentiferous Lead with Zinc, and Copper,	107
	Ballymagrorty, Lead,	103
	Finner, Argentiferous Lead with Zinc, and Copper,	107
	Tonregee, Lead,	107
BUNDORAN,	Vicinity of, Lead and Copper,	106
CARNDONAGH,	**Carrowmore* or *Glentogher*, Argentiferous Lead with Zinc, and Sulphur Ore,	20
	*Clonca, Copper,	4, 5, &c.
DUNFANAGHY,	**Ards*, Lead,	16 & 26

Post Towns.	Localities and Counties.	No. of Ordnance Map.
	DONEGAL, *continued.*	
	**Keeldrum Upper*, Lead, ...	88
	**Marfagh*, Lead, Copper, Sulphur Ore, and Iron, ...	15
GLENTIES, ...	**Drumnacross*, Lead, ...	74
	**Fintown* (*Loughnambraddan*), Lead,—property of James Hamilton, Esq.; see Giesécké's Report to the Royal Dublin Society, ...	66
	*Gweebara River, Lead, ...	65, &c.
	**Kilrean*, Lead, ...	74
	**Mullantiboyle*, Lead,—formerly worked by Sir Albert Conyngham; abandoned from influx of Owenea River,—Griffith, MSS., Mines of Ireland, ...	74
	*Scraig's Mountain, Lead with Zinc, and Sulphur Ore, ...	66 & 67
KILLYBEGS, ...	**Malinbeg*, Argentiferous Lead, and Manganese,—worked by Mr. Willans, . . .	89
LETTERKENNY, . . .	**Eighterross* (*Castlegrove*), Lead, ...	53 & 54
NARAN, ...	*Iniskeel, Coast of, Lead and Copper, . . .	64, &c.
	DOWN.	
ANNALONG, ...	*Glasdrumman, Copper and Lead, ...	53
ARDGLASS, ...	*Ardtole, Lead, ...	45
	*Guns Island, Lead, Copper, and Sulphate of Barytes, ...	39
BRYANSFORD, ...	**Fofanny*, Lead,—Griffith, MSS., Mines of Ireland, ...	48
CRAWFORDSBURN, . .	*Ballyleidy, Lead, ...	1
DROMARA, ...	*Slieve Croob District (Begny, Gransha, Leganany, Moneybane, &c.), Iron, . . .	28, 29, 35, and 36
DROMORE, ...	*Vicinity of, Lead and Manganese, . . .	21, &c.
DUNDRUM, ...	**Moneylane*, Lead, ...	43
	**Wateresk*, Lead,—communicated by Joseph Backhouse, Esq., ...	43
HILLSBOROUGH, . . .	*Carnreagh, Iron, ...	14
KILKEEL, ...	*Leitrim (Leitrim Hill), Lead,—communicated by Dr. Saunderson, ...	55
	**Mourne Mountains*, Copper and Lead, . .	52, &c.
KILLOUGH, ...	*Ballydargan, Lead, ...	44
	**Killough*, Lead, ...	45
	**Rathmullan*, Lead, ...	45
	*Saint John's Point, Copper and Sulphur Ore,	45
KILLYLEAGH, ...	**Corporation*, Lead, ...	31
NEWTOWNARDS, . . .	**Whitespots* (*Conlig*), Lead,—worked by Newtownards Mining Company; see Professor Haughton's Paper on Gangue, "Journ. Geol. Soc. Dub.,"	6
STRANGFORD, ...	**Tullyratty*, Copper and Argentiferous Lead, —Griffith, MSS., ...	31

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	DUBLIN.	
DUBLIN, ...	Ashtown, Lead, ...	14 & 18
	Castleknock, Lead, ...	17
	Cloghran, Lead, ...	14
Clontarf Mines, . . .	*Clontarf*, Lead with Zinc,—first shaft sunk 1809, Griffith, MSS., Mines of Ireland, .	19
	Killester, Lead, ...	19
	Crumlin, Lead, ...	22
	Dolphinsbarn, Lead with Zinc,—abandoned from influx of water; Griffith MSS.,	18
	Kellystown, Lead, ...	13 & 17
	Kilmainham, Lead, ...	18
	Phœnix Park, Lead, ...	18
GOLDEN BALL, ...	**Ballycorus*, *Mount Peru*, Argentiferous Lead with Zinc, and Native Silver, . .	26
Ballycorus Mines, . .	**Rathmichael*, Lead,—worked by the Directors of the Mining Company of Ireland, ...	26
	**Shankill*, Lead, ...	26
HOWTH, ...	**Howth*, Lead, ...	16
Howth Mines, . . .	*Sutton*, Manganese, ...	15
KINGSTOWN, ...	**Dalkey*, Lead with Zinc, and Tin,—Griffith, MSS., ...	23
	**Mount Mapas* (*Killiney Hill*), Lead, . .	23
	*Seapoint, Copper, ...	23
RUSH, ...	*Lambay Island, Copper, ...	9
	Loughshinny, Copper, Griffith's Mining Report of Province of Leinster, . . .	5
	FERMANAGH.	
BELLEEK, ...	Rossbeg (Castle Caldwell), Copper and Iron,—communicated by George C. Mahon, Esq., property of J. C. Bloomfield, Esq., ...	9
	GALWAY.	
ARDRAHAN, ...	Ballymaquiff, Argentiferous Lead,—property of F. M. S. Taylor, Esq., ...	113 & 114
	Muggaunagh, Lead and Copper, . . .	103
	Parkatleva, Lead, ...	103
CLIFDEN, ...	**Ardbear*, Copper, ...	35
	**Boolard*, Copper, ...	22
	**Cloon*, Copper, ...	22
	**Derrylea*, Lead,—worked by Messrs. Gibbs, Baxter, and Reynolds; property of S. Jones, Esq., ...	36
	**Doon*, Copper, ...	22

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	GALWAY, *continued.*	
	**Dooneen*, Copper,—Report by P. J. Foley, Esq., M. E. for Connemara Mining Co., .	22
	**Fakeeragh*, Copper, ...	35
	**High Island*, Copper, ...	21
	**Rinvyle District* (*Dawrosmore*, *Cloonlooaun*, *Cashleen*, &c.), Iron and Copper,—Estate of Archdeacon Wilberforce; see Dr. Apjohn's Paper, Journ. G. S. D.,	9 & 23
GALWAY, ...	*Carrowroe South, Lead, ...	90
	**Derrynea* (*Cashla Bay*), Lead,—Griffith's Lectures on the Mines of Ireland, . .	79
	*Docks of, Mundic, ...	94
	**Inveran*, Lead,—Griffith's Lectures before R. Dub. Soc., Mines of Ireland, . . .	91
	**Kilroe West*, Lead, ...	92
	*Lenaboy (Salthill), Lead,—communicated by John L. Worrall, Esq., C. E., . . .	94
	*Spiddle, Lead, ...	92
KINVARRA, ...	*Caherglassaun*, Argentiferous Lead,—worked by Connemara Mining Company,	122
MOYCULLEN, ...	*Wormhole* (*Gortmore*), Lead, ...	68
ORANMORE, ...	*Rinville West*, Lead with Zinc, and Sulphur Ore, ...	94
OUGHTERARD, ...	**Ballygally*, Sulphur Ore,—formerly worked by Mr. Nimmo, ...	40
Canrawer Mines, . .	**Canrawer, West*, Lead, ...	54
	Gregg, Lead,—communicated by G. F. O'Fflahertie, Esq., ...	54
Claremount Mines, .	**Claremount*, Lead, ...	54
	**Glengowla East and West*, Lead with Zinc,	54
	Tonweeroe, Lead, ...	54
Curraghduff Mines, .	**Barratleva*, Copper,—property of, and worked by, Henry Hodgson, Esq., . .	39
	**Curraghduff Middle* (*Glan*), Copper and Sulphur Ore,—property of W. Downes Griffith, Esq., ...	39
	**Derroura*, Copper, — property of, and worked by, Henry Hodgson, Esq., . .	39
	*Dooghta, Mundic,—communicated by Sir Richard O'Donnell, Bart., ...	26
	**Dooros*, Copper and Sulphur Ore, . . .	39
	**Drumsnauv* (*Doon*), Copper, Manganese, Iron and Lead, ...	39
	* *Griggins*, Argentiferous Lead, ...	25
	*Leenaun, Lead & Copper,—Griffith, MSS.,	12
Lemonfield Mines, .	Ardvarna, Lead, ...	54
	Lemonfield, Silver and Lead,—worked by G. F. O'Fflahertie, Esq., ...	54
	Portacarron, Lead, ...	54
ROUNDSTONE, ...	*Vicinity of, Lead, ...	50

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	KERRY.	
ARDFERT, ...	*Vicinity of*, Lead, ...	20 & 21
CASTLEISLAND, ...	*Clogher*, Silver, Lead, and Copper,—worked by the Royal Hibernian Mining Company, ...	30
CASTLEMAINE, ...	*Annagh* (*East*), Argentiferous Lead with Zinc,—discovered in 1789, on the Godfrey Estate, ...	47
	**Meanus*, Lead and Copper,—Resident Director, John Giles, Esq., ...	47
CAUSEWAY, ...	**Ballinglanna*, Lead, ...	9
	*Coast West of Cashen River, Lead and Copper,—Griffith, MSS., ...	9, &c.
	Lixnaw, *Vicinity of*, Lead, ...	15 & 16
DUNQUIN, ...	*Vicinity of, Copper, ...	52
KENMARE, ...	*Ardtully* (*Cloontoo*), Copper,—worked by Kenmare and West of Ireland Mining Company, ...	93
Lansdowne Mines, . .	*Caher West* (*Shanagarry*), Argentiferous Lead, and Copper, ...	93
	Killowen, Lead, ...	93
	Public Garden of, Lead,—observed by Rev. Professor Haughton, F. T. C. D., .	93
	West of, Copper, ...	93, &c.
KILLARNEY, ...	*Cahernane*, Argentiferous Lead,—Report by M. Raspe in 1761, Griffith, MSS., .	66
	Muckross, Copper, Cobalt, and Sulphur Ore,—Cobalt discovered by M. Raspe in 1794, ...	74
	Ross Island, Copper, and Lead with Zinc, .	66
SNEEM, ...	**Behaghane*, Copper, ...	106
Carrigcrohane Mines, .	**Garrough*, Copper, ...	106
	**Staigue*, Copper,—Griffith, MSS., Mines of Ireland, ...	99
TRALEE, ...	Ballybeggan, Lead and Copper, . . .	29
	Ballymullen, Lead and Copper, . . .	29
	Lissooleen, Silver, Lead, and Copper, .	30
	Oak Park, Lead,—Griffith, MSS., . .	29
	KILDARE.	
CELBRIDGE, ...	Ardclogh, Lead, ...	15
	Wheatfield Upper (*Church Mine*), Lead with Zinc,—Griffith's Mining Report, 1828, ...	15
EDENDERRY, ...	*Freagh*, Lead, ...	8
NEWBRIDGE, ...	*Punchersgrange, Copper,—Griffith, MSS.,	17

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	KILKENNY.	
Castlecomer, ...	*Aghamucky*, Clay-ironstone,— Griffith's Coal Reports, 1814, ...	6
	Coal district, Clay-ironstone,—Estate of Hon. Charles H. Butler C. S. Wandesforde, ...	6, &c.
Inistioge, ...	*Ballygallon (East bank of Nore), Argentiferous Lead,—communicated by Rev. J. Graves, ...	32
Kilmacow, ...	Dunkitt, Lead,—communicated by Samson Carter, Esq., C. E., ...	48
Knocktopher, ...	*Knockadrina* (*Flood Hall*), Lead and Silver;	27
	*Vicinity of, Copper, ...	31
Thomastown, ...	*Grenan, Iron (Micaceous),—Estate of the Right Hon. the Earl of Carrick, . .	28
	KING'S COUNTY.	
Edenderry, ...	*Edenderry* (*Blundell Mine*), Lead, . .	12
Kinnitty, ...	*Slieve Bloom Mountains, Lead and Copper,	36, 37, &c.
	LEITRIM.	
Drumkeeran, ...	*Creevelea District*, Clay-ironstone, . .	15, 16, &c.
Lurganboy, ...	**Gortnaskeagh*, Copper,—Griffith, MSS., .	11
	**Pollboy*, Copper, ...	11
Twigspark Mines, . .	Barrackpark, Argentiferous Lead, . . .	7
	Twigspark, Argentiferous Lead, . . .	7
Mohill, ...	**Gortinee*, Iron, ...	35
	LIMERICK.	
Askeaton, ...	*Ballycanauna* (*Ballysteen*), Argentiferous Lead and Silver,—Griffith, MSS., . .	11
Doon, ...	Carrigbeg (Castletown), Lead,—communicated by Professor Apjohn, T. C. D., and R. Hodgson Smyth, of London, Esq., property of Captain Hore, . .	25
Oola, ...	*Oolahills*, Copper, Argentiferous Lead, and Sulphur Ore,—worked by Oola Silver, Lead, and Copper Mining Company, ...	25
Newcastle, ...	*Mahoonagh*, *Vicinity of*, Lead, ...	36
Rathkeale, ...	*Ballydoole*, Argentiferous Lead, communicated by J. L. Worrall, of Limerick, Esq., C. E., ...	3
Pallaskenry, ...	*Cloghatrida*, Argentiferous Lead, . . .	20

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	LONGFORD.	
LONGFORD, ...	*Vicinity of, Argentiferous Lead,—Griffith, MSS., ...	14
SCRABBY, ...	**Cleenrah*, Iron, ...	8
	LOUTH.	
CLOGHER, ...	*Clogher, Copper,—Gossan on Shore, Griffith, MSS., ...	22
DROGHEDA, ...	*Oldbridge, West of, Lead and Copper, .	28 & 24
DUNDALK, ...	*Crumlin, Lead, ...	7
	*Fairhill, Lead,—communicated by the Hon. Captain Jocelyn, ...	7
JONESBOROUGH, . . .	*Vicinity of, Antimony, ...	1
TOGHER, ...	**Salterstown*, Lead and Copper,—Griffith's Mining Report, ...	16
	MAYO.	
BALLYCASTLE, ...	*Belderg More, Copper,—communicated by R. W. Townsend, Esq., ...	6
	*Geevraun, Copper, ...	5
BALLYHAUNIS, . . .	Ballynastockagh (Bellaveel), Traces of Lead,—Estate of J. Birmingham, Esq.,	108
LOUISBURGH, ...	*Vicinity of, Copper and Sulphur Ore,—communicated by Sir Rd. O'Donnell, Bart.,	86
NEWPORT, ...	*Achill Island, South Western Shore of, Mundic,—communicated by Sir Rd. O'Donnell, Bart., ...	65
	*Clare Island, Sulphur Ore, ...	85, &c.
Corraun Mines, . .	**Bolinglana* (*Clew Bay*), Copper, Sulphur Ore, and Argentiferous Lead, . . .	75
	**Srahmore* (*Clew Bay*), Copper, Sulphur Ore, and Argentiferous Lead,—Estate of Sir R. O'Donnell, Bart., ...	65
WESTPORT, ...	**Tawnycrower* (*Sheeffry*), Argentiferous Lead, ...	107
	MEATH.	
ARDCATH, ...	**Cloghan*, Lead,—very ancient, Griffith, MSS., ...	33
ATHBOY, ...	*South of*, Lead, ...	29 & 35
SLANE, ... *Beaupark Mines*,	Dollardstown, Copper and Lead,—Griffith's Mining Report, ...	26
	Painestown, Copper, ...	26
WALTERSTOWN, . . .	*Brownstown*, Copper, worked in the year 1800 by Sir J. Dillon, Chs. Dillon, and N. Preston, Esqrs.; Griffith, MSS., .	32
	Cusuckstown, Copper, ...	32
	Kentstown, Copper, ...	32

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	MONAGHAN.	
BALLYBAY, ...	*Corbrack, Lead, ...	19 & 24
	*Cornamucklagh, South, Lead, ...	19
	**Dernaclug*, Lead, ...	19
	**Derrylusk*, Lead, ...	14
	*Sra, Lead, ...	24
BELLANODE, ...	*Derryleedigan Jackson*, Lead with Zinc—Griffith, MSS., ...	8
BELLATRAIN, ...	*Corduff, Manganese, ...	27
CARRICKMACROSS, . . .	*Knocknacran East*, thick beds of Gypsum,—worked by Evelyn John Shirley, Esq., ...	31
CASTLEBLAYNEY, . . .	**Carrickagarvan*, Argentiferous Lead and Sulphate of Barytes, ...	25
	**Cornalough*, Argentiferous Lead and Sulphate of Barytes, ...	25
	**Dromore*, Lead,—communicated by Joseph Backhouse, Esq., ...	25
MONAGHAN, ...	**Annaglogh*, Lead,—worked by James Skimming, Esq., ...	15
	*Annayalla, Lead, ...	19
	*Avalbane, Lead,—communicated by William Conn, Esq., ...	14
	**Avalreagh*, Lead with Zinc, ...	14
	**Carrickaderry*, Lead,—formerly worked by Mr. Bearcroft,—Griffith, MSS., .	14
	*Carrickanure, Lead, ...	14
	**Coolartragh* (*Bond*), Argentiferous Lead with Zinc, and Sulphate of Barytes,—worked by William Conn, Esq., . .	14
	*Cornamucklagh North, Lead,—communicated by William Conn, Esq., . . .	14
	*Croaghan, Lead, ...	14
Clontibret Mines, . .	*Crossmore, Lead, ...	14
	*Glassdrumman East, Lead, ...	14
	*Kilcrow, Lead with Zinc, ...	14
	*Latnakelly, Lead,—communicated by William Conn, Esq., ...	14
	**Lemgare*, Lead, ...	14
	**Lisdrumgormly*, Lead, ...	15
	**Lisglassan*, Lead and Antimony, . . .	14
	**Tassan*, Lead,—discovered and worked by Joseph Backhouse, Esq.; see Letter in "Mining Journal," by Joseph Holdsworth, Esq., ...	14
	*Tonnagh, Lead, ...	14
	**Tullybuck*, Lead and Antimony,—formerly worked by Lord Middleton,—Griffith, MSS., ...	14

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	QUEEN'S COUNTY.	
MARYBOROUGH, ...	Dysart, Iron (Hematite),—Property of Lord Carew; see Professor Apjohn's analysis, ...	13 & 18
	ROSCOMMON.	
KEADEW, ...	*Altagowlan, Lough Allen East side, base of Slieve Aneirin, &c.* (*Arigna District, partly in Leitrim*), See Griffith's Coal Reports, ...	2
	SLIGO.	
BALLYSADARE, ...	*Abbeytown*, Lead and Silver, Griffith, MSS.,	20
	**Lugawarry*, Lead, ...	20
SLIGO, ... *King's Mountain Mines*,	*Glencarbury*, Copper, Lead, and Sulphate of Barytes,—Estate of the late Erasmus Smith, ...	6 & 9
	Tormore, Copper and Lead, ...	9
	TIPPERARY.	
BORR'SOLEIGH, ...	*Cooleen, Lead, ...	33 & 34
CAPPAGHWHITE, ...	**Clonmurragha*, Copper, ...	45
	**Gleenough Upper*, Copper, ...	45
	**Lackenacreena*, Copper, ...	45
Hollyford Mines, ...	**Reafadda*, Copper, ...	45
DUNKERRIN, ...	**Rathnaveoge Lower*, Copper, worked perhaps in the seventeenth century, Griffith, MSS., ...	17
NEWPORT, ...	**Lackamore*, Copper, ...	38
Lackamore Mines, ..	**Tooreen Brien Upper*, Copper, ...	38
PORTROE, ...	*Corbally, Lead (*Imperial Slate Works, William Headech, Esq., Proprietor*), . .	19
	*Derry Demesne, Copper,—Griffith, MSS., Mines of Ireland, ...	19
	**Garrykennedy*, Lead, ...	18
	**Laghtea*, Lead, ...	19
SILVERMINES, ...	**Ballygowan South* (*Silvermines*), Argentiferous Lead,—worked by the General Mining Company for Ireland,—George M'Dowell, Esq., F.T.C.D., Sir J. Murray, &c., Directors, ...	26
	**Cloonanagh*, Sulphur Ore,—Griffith, MSS.,	26
	**Cooleen*, Lead, ...	26
	**Coolruntha*, Copper, ...	32
	Garryard East, Lead and Copper, both Argentiferous, ...	26

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	TIPPERARY, *continued.*	
	**Garryard West*, Lead and Copper, both Argentiferous, ...	26
	**Gorteenadiha*, (*Gurtnadyne*), Lead and Copper, both Argentiferous, ...	26
	**Gortshaneroe* (*Ballynoe*), Lead and Copper, both Argentiferous, ...	26
	**Knockanroe*, Lead with Zinc, Copper and Sulphur Ore, ...	26
	**Shallee Coughlan and White* (*East and West*), Lead, Silver, and Copper,—Report, H. English, Esq., ...	26
TIPPERARY, ...	*Aherlow Vale*, Argentiferous Lead, Copper, and Manganese, ...	74
	TYRONE.	
COAL ISLAND, ...	*Annagher*, Clay-ironstone,—Griffith's Coal Reports, ...	47
COOKSTOWN, ...	*Unagh (Slieve Gallion), Iron, ...	29
GORTIN, ...	*Crockanboy, Lead, ...	19 & 27
	*Munterlony Mountains, Antimony,—Estate of George Knox, Esq.; Griffith, MSS., ...	12 & 19
	*Teebane, West, Lead, ...	19
POMEROY, ...	*Crannogue, Copper, ...	45
	WATERFORD.	
ANNESTOWN, ...	*Knockane, Copper, ...	25
	**Woodstown*, Copper, ...	25
BUNMAHON, ...		
Knockmahon Mines,	**Ballydowane*, Copper and Argentiferous Lead,—worked by Mining Company of Ireland, ...	24
	**Ballynagigla*, Copper, ...	25
	**Ballynarrid*, Copper, ...	24
	**Ballynasissala*, Copper, ...	24 & 25
	**Kilduane*, Copper and Native Ore, . .	25
	**Kilmurrin*, Copper, ...	25
	**Knockmahon*, Copper, Argentiferous Lead with Zinc, and Cobalt,—discovered by J.H. Holdsworth, Esq.; see Journ. G.S.D.	25
	**Tankardstown*, Copper, ...	25
	**Templeyvrick* (*Trawnastrella and Trawnamoe*), Copper, ...	24
	**Seafield*, Copper, ...	24
BALLYNAMULT, ...	*Carrigroe, Copper,—communicated by R. W. Townsend, Esq., ...	18
	**Knockatrellane* (*Ballymacarbry*), Copper, Griffith, MSS., ...	5

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	WATERFORD, *continued.*	
CARRICK-ON-SUIR, ...	*Killerguile, Iron (Micaceous), ...	7
	*Monminane, Lead, ...	7
DUNGARVAN, ...	**Drumslig* (*Slieve Grian*), Iron,—discovered and worked by Sir Walter Raleigh, . .	85
STRADBALLY, ...	**Killelton* (*Lady's Cove*), Copper, . . .	82
	**Kilminnin*, Copper, ...	24
TRAMORE, ...	*Ballykinsella, Copper, ...	17
YOUGHAL, ...	*Coast opposite, Lead,—Griffith, MSS., .	40
	WEXFORD.	
CARRICK, ...	**Barrystown*, Argentiferous Lead with Zinc, and Iron,—worked 65 years ago by Mr. Ogle, ...	45
ENNISCORTHY, ...	**Aughathlappa*, Argentiferous Lead, . .	19
	*Bree, Mundic, ...	25
	**Caim*, Argentiferous Lead, with Zinc, Copper, Iron, and Sulphur Ore, ...	19
	**Killoughrum*, Lead, ...	19
	*Mangan, Lead, ...	19
RIVERCHAPEL, ...	*Courtown Harbour, Iron, ...	12
WEXFORD, ...	*Kerloge, Copper,—the ore is Malachite, Griffith, MSS., ...	42
	WICKLOW.	
ANNAMOE, ...	**Brockagh* (*Luganure, Glendasan*), Lead, —Griffith's Mining Report, ...	17
Glendalough Mine, .	**Lugduff*, Lead, Copper, and Iron—(this group contains Ruplagh, Hero, Hawk Rock, Van Diemen's Lodes, &c.), . .	28
	**Seven Churches or Camaderry* (*Luganure, Glendasan*), Argentiferous Lead, and Copper with Zinc, ...	17 & 28
ARKLOW, ...	*Aughrim Lower, Copper, ...	34
	**Ballinagore*, Copper, ...	39
	**Ballintemple*, Lead, ...	40
	**Ballycoog Upper*, Copper and Iron, . .	39
	*Clonwilliam, Lead,—See Report by Warrington W. Smith, Esq., M. A., of Geol. Survey, ...	40
	**Coolbawn, or Coolbalintaggart*, Particles of Gold, ...	39
	**Goldmines River*, particles of Gold and Tin,	40
	*Killacloran, particles of Gold,—communicated by Joseph Backhouse, Esq., . .	39
	**Knocknamohill*, Copper and Iron, . . .	40
	**Moneyteige Middle and South*, Copper, Iron, and particles of Gold, ...	39

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BALLINALEA,	**Ashford*, Copper,	25
	**Ballymacahara*, Copper,	25
BALTINGLASS,	*Boleylug (Moatamoy), Lead,—Griffith's Mining Report,	27
BLESSINGTON,	*Cloghleagh (Glenasplinkeen), Manganese; and Hematic Iron containing peroxides 84, or Metallic Iron 59 per cent., — Professor Haughton's Analysis,	6
	*Knockatillane (Glenasplinkeen), Manganese; and Hematic Iron containing peroxides 84, or Metallic Iron 59 per cent., — Professor Haughton's Analysis,	5
BRAY,	*Bray Head, Copper,	8
ENNISKERRY,	**Douce Mountain*, Lead and Copper,	12, &c.
	**Powerscourt*, Lead and Copper,—Griffith's Mining Report,	7, &c.
HOLLYWOOD,	**Glen of*, Lead,—See Report by Sir Richard Griffith, Bart., LL. D.,	9
KILTEGAN,	*Aghavannagh Mountain,— Lead and Copper,	28
RATHDRUM,	*Ballinacarrig Lower, Copper,	35
	*Ballinaclash, Lead,	35
	**Ballinagappoge*, particles of Gold and Tin,	34
	**Ballycreen*, particles of Gold,—See on Geology of the East of Ireland, by Mr. Weaver,	34
	**Ballygahan Lower and Upper* (*Ovoca*), Copper and Sulphur Ore,—worked by Henry Hodgson, Esq.,	35
	**Ballymoneen*, Copper, Iron, and Sulphur Ore,—Griffith, MSS.,	35
Ballymurtagh Mines,	**Ballymurtagh* (*Ovoca*), Copper with Zinc, Sulphur Ore, Iron and Auriferous Gossan,—Apjohn,	35
	**Kilcashel*, Copper and Sulphur Ore,—worked by Wicklow Copper Mine Co.,	35
	**Castlehoward*, Copper and Sulphur Ore,	35
	**Connary Upper*, Copper, Lead with Zinc, Sulphur Ore, Antimony, Arsenic, and Auriferous Silver,	35
	**Cronebane* (*Ovoca*), Copper with Zinc, Sulphur Ore, Auriferous Silver, and Lead,	35
Glenmalur Mines,	**Ballinafunshoge*, Lead with Zinc,—Griffith's Mining Report,	23
	**Ballinagoneen*, Lead with Zinc, and Copper,—worked by Sir C. P. Roney, &c.,	22 & 23
	*Ballyboy, Lead,	28
	**Baravore*, Lead,	23
	*Camenabologue, Lead and Copper,	22
	**Clonkeen*, Lead with Zinc, and Iron,	23
	*Clonvalla, Lead,	22
	**Corrasillagh*, Lead with Zinc,	28
	**Cullentragh Park*, Lead,	23

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	WICKLOW, *continued.*	
	**Killeagh*(*Ovoca*), Copper and Sulphur Ore,	35
	**Kilmacoo and Upper*, (*Ovoca*), Copper,	35
	**Knockanode* (*Ovoca*), Lead and Sulphur Ore,—worked by Captain Laffan, M. P., property of George C. Mahon, Esq.—See Weaver's Geology of the East of Ireland, Trans. Geol. Soc. Lond.,	35
	*Templeluak, Sulphur Ore,—communicated by Joseph Backhouse, Esq.,	35
	**Tigroney East and West* (*Ovoca*), Copper, and Sulphur Ore,—worked by Messrs. Williams,	35
	*Vicinity of, Copper,	30
REDCROSS,	**Templelyon*, Iron, Copper, and Sulphur Ore, — property of Wentworth Erck, Esq.,	36
ROUNDWOOD,	**Lough Dan*, Lead with Zinc, and Copper,	17
	**Lough Tay*, Lead,	12
SHILLELAGH,	**Vicinity of*, Lead,—Report by Sir Richard Griffith, Bart., LL. D., Insp.-General of her Majesty's Royal Mines in Ireland, Commissioner of the General Valuation of Ireland, &c., &c.,	43
TINAHELY,	**Carrigroe*, Lead,	38

XXVI.—Catalogue of a Geological and Geographical Collection of Minerals from the Arctic Regions, from Cape Farewell to Baffin's Bay. Lat. 59° 14′ N., to 76° 32′ N.

By the late Sir Charles Giesecké, Professor of Mineralogy to the Royal Dublin Society.

[The localities thus marked (*) are to be found on the Map published in the "Transactions of the Royal Irish Academy," to accompany Sir Charles Giesecké's paper "On the Norwegian Settlements on the Eastern Coast of Greenland, or Osterbygd, and their Situation."—January 26, 1824.—Ed.]

EASTERN COAST OF GREENLAND.

1. *Allik, or Allùk.**

1. Red, coarse, granular Granite, with white Mica, from the island of Allùk.
2. Tourmaline, in nine-sided prisms, from the same place.

2. *Kippingajak.* (*Continent.*)

3. Syenite, with little Hornblende, resting upon Granite.
4. Precious Garnet, in Mica Slate, from the same place.

3. *Nunarsveitsiak.* (*Island.*)

5. White, fine, granular Granite.
6. Hemispherical Mica (rather botryoidal), imbedded in Quartz.

4. *Akajarosanik.* (*Island.*)

7. Thin, slaty Mica Slate (the predominant rock).
8. Bacillar Quartz, of a greyish and yellowish-white colour.
9. Common Asbestus, imbedded in Talc.

5. *Kakasoeitsiak.* (*Continent.*)

10. Coarse, granular, white Granite.
11. Milk Quartz, in detached pieces.
12. Allanite, crystallized in six-sided prisms, imbedded in Granite.
13. Hornblende rock, resting upon Granite.
14. Loose pieces of Aventurine Quartz.

6. *Akajorosak* (*Island.*)

15. Talcose Mica Slate, with extensive Beds of common slaty Talc.

7. *Krippioakko.* (*Island.*)

16. Red, coarse, granular Granite, sometimes interspersed with Garnets.
17. Greenstone-like Basalt, in veins intersecting the Granite.
18. Mica Slate, resting upon Granite.
19. Hornstone, in loose Blocks.

SOUTHERN COAST OF GREENLAND.

Taraserseak. (*The Sound between the Islands of Staatenhuk, Cape Farewell, and the Continent of Greenland.*)

8. *Ikkartorsoit.* (*Continent.*)

20. Fine, granular, grey Granite, the constituent mass of the mountains.
21. Green Granite, with green Mica, superincumbent.

9. *Narksoitsiak.* (*Continent.*)

Fine, granular, grey Granite, as the former.

22. Dark-blue Quartz, with imbedded, green Garnets, forming veins in the Granite.

23. Common, black Schorl, forming veins in the same Granite.
24. A yellowish-brown Talcose mineral, resembling the Triclasit of Hausman.

10. *Sertak.* (*Island.*)

Fine, granular, grey Granite, as before.
25. Grey Mica Slate, covering the Granite, sometimes with Garnets.

ISLANDS OF STATENHUK, OR KANGERSOAK.*

Fine, granular, grey Granite, throughout.

11. *Kangek Kyadlek.** (*Their most eastern point.*)

26. Reddish, fine, granular Granite.
27. Actinolithe, imbedded in Talc.
28. Iron Pyrites, in loose cubes.
29. Common Hornblende.
30. Rock Crystals, loose, found in the streams.

12. *Omenak.**

Rocks, as before.

13. *Illuarmiut.* (*A Firth in the continental land.*)

Red, coarse, granular Granite.
Hornblende Slate, in beds.
31. Labradoric Hornblende, in beds.

14. *Ikartlorsoak.* (*An isolated rock.*)

Grey Granite, with beds of Mica Slate.

15. *Pamiarsuk, or Pamiedluk.* (*Island.*)

Grey, coarse, granular Granite, alternating with Red Granite.
32. Glassy-grey Felspar, loose, forming a decomposed vein in Granite.
33. Tourmaline, in fragments.
34. Garnets, loose.

16. *Nunarsoak.* (*Island.*)

Grey, fine, granular Granite, as before.
35. Chlorite Slate, in beds.
36. Greenstone-like Basalt (whin dykes), forming narrow veins in the Granite.

17. *Tippok.* (*An isolated Mountain.*)

Grey, fine, granular Granite, as before.
37. Hornblende Slate, forming beds in the Granite.
38 to 44. Primitive gravel, forming a natural pier.

18. *Pysursoak.* (*A Firth, leading for 48 miles to the interior of the Continent.*)

Grey, fine, granular Granite, as above (ironshot).
45. Whitestone, of Werner, in beds, schistous.
46. Ironshot, primitive Greenstone, in beds.
47. Indigolithe, in Granite.
48. Rock Crystals, in fragments.
49. Red, common Jasper, in boulders.

19. *Najak, or Nujak.* (*A Mountain in the interior of the Firth of Pysursoak.*)

50. Grey ironshot Syenite.
51. Primitive Greenstone, forming beds in it.
52. Tinstone, in small grains, along the shore.
Zirkon, in coarse, granular Syenite.
53. Rock Crystals, in veins, in Syenite.

20. *Korossoak.* (*Continent.*)

Grey, fine, granular Granite, as above.
54. Mica Slate, on the foot of the mountains, resting upon Granite (coarse slaty).
55. Garnets, loose along the shores.

21. *Nappersoak.* (*The Firth of Nappersoak.*)

Fine granular, grey Granite, as above.
56. Mica Slate, sometimes with small Garnets.

22. *Unnuarsuk.* (*A narrow Sound.*)

57. Reddish-white, coarse, granular Granite.
58. Pearl-grey Milk Quartz, in scattered fragments.

23. *Nettingiak.* (*Continent.*)

59. Common Hornblende. Beds in grey Granite, as above.
60. Common white Quartz, forming beds.

24. *Tinguorsoit.* (*A chain of high, precipitous Mountains.*)

Grey, fine, granular Granite, as above.

25. *Nenortelik.* (*Island.*)

Grey, fine, granular Granite, as above.
61. Tourmaline, in Granite.
62. Arsenical Pyrites, in Gneiss.
63. Graphite, in Granite.
64. Grey Hornstone, in boulders.
65. Bluish-grey Clay, along the shores.

26. *Tuapek.* (*Island*).

66. Whitish-grey Granite.

27. *Tessermiut.* A large Firth.* (*Continent.*)

Grey, fine, granular Granite, as above.
67. Mica Slate.
68. Rock Crystals, of a greenish tinge, loose.

28. *Mountain Amiktok.* (*Island.*)

Grey, fine, granular Granite, as above.
69. Labrador Felspar, in boulders.

29. *Angmalortok Mountain.* (*Island.*)

Grey, fine, granular Granite, as above.
70. Hornblende Rock, in beds.

30. *Kognamiut.* (*Continent.*)

71. Reddish-white, coarse, granular Granite.
72. Moroxite, in small Prisms in Granite.

31. *Ikaresusuk.* (*Island.*)

73. Reddish-white, coarse, granular Granite, as before.
74. Moroxite, in small Prisms, in Granite.

32. *Sermesok,* or Cape Farewell.* (*Large Island.*)
Ikariut, or Kallerit of Eggers.—(*A Point of Cape Farewell.*)

75. White, coarse, granular Granite.

33. *Kangek, or Peninsula of Kikertaursak.* (*Cape Farewell.*)

76. Fine, granular, grey Granite, as above.
77. Common Quartz, veins in Granite.
78. Common Hornblende, in beds,
79. Splintery Hornstone, in boulders.
80. Fergusonite, in double, four-sided Pyramids, imbedded in Syenitic Granite.

34. *Karsitsiak.* (*Point of Cape Farewell.*)

Grey, fine, granular Granite, as above.
81. White, Calcareous Spar, in veins, in Granite.

35. *Niakornak.* (*Upon Cape Farewell.*)

Grey, fine, granular Granite, as above.
82. Crystallized white Felspar.

36. *Kikertarsoertsiak.* (*Island.*)

Grey, fine, granular Granite, as above.

37. *Anartursok.* (*Island.*)

83. Syenitic Granite, with much Hornblende.

WESTERN COAST OF GREENLAND.

38. *Tyktuktuarsuk.* (*Island.*)

84. Red, coarse, granular Granite.
85. Mica Slate. (Beds in the Granite.)

39. *Ounartok.** (*Island.*)

Grey, fine, granular Granite, as above.

86. Siliceous Stalactite, deposited upon the gravel of the hot spring.

40. [No locality recorded.—Ed.]

Grey, fine, granular Granite, as before.

87. Hornblende Rock.
88. Milk Quartz, in small beds.

41. *Lichtenau, or Agluitsok.** (*In the Firth of Agluitsok. A Settlement of the Moravian Brethren.*)

89. Granite, with imbedded Garnets.
90. Chlorite Slate.

42. *Sergvartursok.* (*Continent.*)

91. Granite, with reddish-white Felspar.

43. *Kaksersoak.* (*Island.*)

92. White, fine, granular Granite.

44. *Ujarartarbik.* (*Island.*)

93. Coarsely schistous Mica Slate.

45. *Karsok.** (*Continent.*)

94. Fine granular Granite, with red Felspar.
95. Prismatic Felspar, in a porous
96. Massive Epidote, in boulders.
97. Common Quartz, crystallized in prisms.

46. *Omenarsuk, Omenarsoak, Omenalik, Omenak, Upernavik, and Sadlok.** (*Six small Islands.*)

98. Fine granular Granite, with red Felspar.
99. Massive Epidote, in Granite.
100. Mica Slate, in extensive beds.

47. *Akkia, or Mathiesen's* (*Stachs*) *Island.*

Grey, fine, granular Granite, as above.

101. Porous greenstone-like Basalt.

THE FIRTH OF IGALIKKO.*

48. *Kikertarsoak, or Kobberoe.* (*Island.*)

Fine, granular, grey Granite, as before.
102. Schistous Copperglance, in Quartz.
103. Indurated Talc, in small nests.
104. Greenish-white common Quartz.
105. Coppergreen, in common Quartz.
Gneiss, in columnar pieces.
106. Ironsilex, in boulders.
107. Greenstone-like Basalt.
108. Milk Quartz, in detached pieces.

49. *Redekammen, or Illejutits.* (*Continent.*)

109. Coarse, granular Syenite, constituent mass.
110. Blackish-blue, large, lamellar Hornblende.
111. Fibrous blue Phosphate of Iron.
112. Labrador Felspar, of different shades.
113. Green Felspar.

50. *Kirkefield, or Okallubbiub kakat.* (*Continent.*)

114. White, fine, granular Granite.
115. Rock Crystals, white, loose.
116. Rock Crystal, coloured green by Chlorites.
117. Greyish-white Quartz, in beds.
118. Labrador Felspar, in small, rounded pieces.

51. *Upernaviarsuk.* (*Continent.*)

119. Syenite, with red Felspar.

52. *Mursotut.* (*Continent.*)

Syenite, with red Felspar, as before.

53. *Imnarsoak.* (*Continent.*)

Syenite, with red Felspar, as before

54. *Sirksaluktok.* (*Continent.*)

Syenite, with red Granite, as before.
Hornblende Slate, in beds.

55. *Nulluk.* (*Continent.*)

Primitive Greenstone, as the constituent rock.
120. Chlorite Slate, in beds.
121. Brown-red Iron clay.

56. *Itivlik, or the end of Igalikko Firth.* (*Continent.*)

Grey, fine, granular Granite.
122. Old, red, sandy Claystone, resting upon Granite.
123. Rock Crystals, forming veins in Granite.
124. Rock Crystals, acuminated on both ends, in veins.
125. Thin, slaty Quartz, in Granite.
126. Compact Manganese, forming beds in the old red Sandstone.

57. *Nouga. Eastern Coast of the Firth Igalikko.* (*Continent.*)

127. Red, fine, granular Granite.

58. *Nuniariarbik.* (*Continent.*)

Red, fine, granular Granite, as above.

59. *Akulliarasiarsuk. Eastern Branch of the Firth of Igalikko.* (*Continent.*)

128. Reddish-brown Claystone.
129. Gieseckite, crystallized in six-sided Prisms, imbedded in Clay Porphyry.
130. Felspar, in four-sided Prisms, in the same mass.
Hornstone, in boulders.

60. *Kangermintset.* (*Continent.*)

131. Red, coarse, granular Granite.

61. *Niakornarsoak.* (*Continent.*)

Red, fine, granular Granite, as above.
Hornblende Slate, resting upon the Granite.

62. *Julianeshaab.** (*A Danish Settlement. Greenlandish; Kakortok.*)

Red, fine, granular Granite, as above.
132. Common, white Quartz, in beds.
133. Greenish-white Quartz, with calcareous Spar.
134. Compact Fluor, in Hornblende Slate, in veins.

63. *Kakortok.** (*Continent.*)

White, coarse, granular Granite.

64. *Pilepilar Islands.* (*Iteblilit, upon Pardlit.*)

135. Greenish-white Felspar.

65. *Uglespeils Bageroon.* (*Continent.*)

White, coarse, granular Granite.

66. *Ikaresak.* (*Island.*)

Fine, granular, grey Granite.

67. *Ikertongoak.* (*Island, at the mouth of the Firth of Igalikko.*)

Grey, fine, granular Granite.
136. Leek-green Jasper, in veins, in the Granite.

68. *Matuk Mountain.* (*Island.*)

137. Red, fine, granular Syenite.
Primitive Greenstone.

69. *Kingiktok Mountain.* (*Island.*)

Grey, fine, granular Granite, as before.
Greenstone-like Basalt, in veins.
138. White Quartz, in extensive beds.

70. *The Firth, Kangerdluarsuk* its southern Coast.*

71. *Sigitæt.* (*Continent.*)

Red, coarse, granular Granite.

72. *Nunasornaursak Mountain, or Nunarsoout.* (*Continent.*)
Northern Coast of the Firth.

Coarse, granular, red Granite.
139. Whitestone, in extensive beds.
140. Graphite, occurring in Mica Slate.
141. Yellow sparry Iron Ore.
142. Calcareous Spar, massive, and in six-sided pyramids.
143. Fluor Spar, massive.
144. Sodalite (Mylopsite), in Whitestone.
145. Eudiolithe, in dodekahedrons, in Whitestone.
146. Eudiolithe, in fragments.
147. Apple-green massive Felspar.

73. *Angmasivik; and*
74. *Akulliarsuk.* (*Continent.*)

148. Hornstone porphyry, the predominant rock.

75. *Tunagliarbik.** (*An extensive Firth of* 20 *miles' length. Sik-Sacrie sok, or northern part of Nunasornaursak.*)

149. Syenite, constituent rock.
150. Granular green Quartz.

76. *Nunasornak Mountain.* (*Continent.*)

151. Prehnite, in Greenstone.
152. Crystallized red Felspar, in Greenstone.

77. *Pertiksut.* 78. *Karsotut.*
79. *Ikarblat.* 80. *Kangersuangoak.*
81. *Akulliaralek.* 82. *Kingoa.**

153. Old red Sandstone, spotted, or striped. (Belonging to the old Sandstone formation, with the following:—

83. *Kortlortòk.* **84.** *Naviarsoit.*
85. *Nukpadlartok.* **86.** *Iliotortafik, and*
87. *Sidlisit.*

All belonging to the old red Sandstone formation.)

88. *Korossoak, a narrow Bay of the Firth of Tunugliarbik, close to the Glaciers.*

154. Granite, with white Felspar.
155. Magnetic Iron-ore, massive, and in dodekahedrons.
156. Skorza [Qu., Skorodite.—Ed.], with Iron-ore.
157. Hornblende, in rhomboids.
158. Apophyllite, in fragments.
159. Fibrous Phosphate of Iron.

89. *Mountain Narksak, Illimoasabkakat.*

90. *Karmot.*

160. Blue schistous Jasper.

91. *Firth of Sermilik.** **92.** *Island Irserut.*
93. *Island Ikaresarsuk.* **94.** *Kernertongoit.*
95. *Kakelissitsiak.*

Belong to the primitive grey Granite.

96. *Nunarsoit, Cape of Desolation. (Large Island.)*

97. *Amiatafik.* **98.** *Niakornak.*
99. *Kitiksut. (Islands.)*

Belong to an extensive formation of Zirkon Syenite.

161. Zirkon, in Syenite.
162. Ironchrome (Chromate of Iron), in Syenite.

100. *Kikertangoak.* **101.** *Iliolingoak.*
102. *Sennerut, and Krippisakko.*
103. *Kornok.* **104.** *Ujorbik.*
105. *Imnak.* **106.** *Kognekpamiedluat.*
107. *Ilundeoe.*

Belong to the above-mentioned Granitic formation.

163. Labradorite and Adular, in Syenitic Granite.
164. Corindon, in Granite.
165. Blue Quartz, in veins, from Ilundeoe.

Firth of Arksut.

108. *Tuapeitsiak.* **109.** *Tuapeit.*

Belonging to the Granite and Gneiss formation.

166. Green Jasper, in Granite.
167. Acicular Quartz Prisms, in veins.

110. *Ikek.* **111.** *Ivikat.* **112.** *Kakortongoak.*

Gneiss, as the predominating rock.

168. Tinstone, in Quartz, forming veins.
169. Arsenical Pyrites.
170. White Kryolithe, in beds.
171. Orange-yellow Kryolithe.
172. Kryolithe, with sparry Iron-ore.
173. Common Galena, with Kryolithe.
174. Copper Pyrites, with Kryolithe.
175. Common Quartz, with Kryolithe.
176. Hepatic, compact Fluor, in veins.
177. Earthy Kryolithe.

113. *Kikertarsoak, or Arksuts Storöe.*

Iron-shot Syenite, predominating mass.

114. *Isfamiut.* **115.** *Sermesut.*
116. *Torngarsuk.* **117.** *Ekalluangoit.*
118. *Tiksalik.* **119.** *Kangarsuk.*
120. *Omenarsuk.*

Granite, alternating with Gneiss and Mica Slate.

120. [There is an error in the numbering of this locality.—Ed.] *Kingiktorsoak, or Tindingen.*

Reddish-white Granite.
Mica Slate, resting upon it.

178. Allanite, in Granite.
179. Common Talc, in beds.
180. Precious Serpentine, with Amianth.
181. Axestone.
182. Loose Rock Crystals.
183. Magnetic Iron-ore, in Serpentine.
184. Magnetic Iron-sand.

121. *Ikaresarsuk.* **122.** *Kingiktoarsoit.*
123. *Narksalik.* **124.** *Kvanesok.*
125. *Karsut.*

Granite, alternating, and covered with Mica Slate.

126. *Fredrikshaab, or Pamiut.* (*A Danish Settlement.*)

185. Ironshot, decomposed Syenite.
Black Mica Slate.
186. Moroxite, in six-sided Prisms, in Black Mica Slate.

127. *Londre Storoe, or Kikertarsoak.*

128. *Sioramiut.*

129. *Sakriesok.*

130. *Pukkitsok.*

131. *Tulugartelik, near the great Glaciers.*

Granite, alternating with Mica Slate.

187. Fine Quartz (Flying Sand), along the Glaciers.

132. *Ikertok.* (*A Bay.*)

188. Mica Slate, with Garnets.
189. Garnets, loose, in Dodekahedrons, and different.

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198. Modifications of it.
199. Figurated Talc.
200. Chlorites, crystallized, in Tables.

133. *Ravns Storoe.* **134.** *Langeland.*

135. *Aglomersæt, or Bærsund.*

Mica Slate, alternating with Siliceous Slate.

136. *Lichtenfels.* (*A Moravian Settlement.*)

Mica Slate.

201. Siliceous Conglomerate.

137. *Okaitsungoit.* **138.** *Kardlisofik.* **139.** *Kangarsuk.*

Fine granular Granite.
Mica Slate, with beds of Hornblende Slate.
Siliceous Conglomerate.

202. Very much decomposed Hornblende Slate.
203. Decomposed Greenstone.

140. *Fiskenæs, or Kikertarsoeitsiak.* (*A Danish Settlement.*)

204. Gneiss, with imbedded Garnets.
205. Mica Slate, in extensive beds.
206. Bluish-white and blackish-blue Milk Quartz.
207. Titanite, in Quartz and Calcareous Spar.
208. Allanite, in veins of Felspar.
209. Sapphirine, in Mica Slate.
210. Sapphirine, with Tremolithe and Quartz.
211. Precious Garnet, in Gneiss.

141. *Kangarsuk.* **142.** *Innuksuktusut.*

143. *Grædefiord.* **144.** *Kakkarsoak.*

145. *Ukusiksæt.* **146.** *Kiklawait.*

147. *Makkarsoak.* **148.** *Klingarne.*

149. *Sennerak.* **150.** *Ikatupersoit.*

151. *Kankerdluarsungoak.*

Granite, alternating with Quartz and Mica Slate.

Firth of Buxe.

152. *Simiutak.* (*Island.*)

212. Mica Slate, with precious Garnet.
213. Blue Milk Quartz.
214. Yellow Milk Quartz.
215. Red Milk Quartz.
216. Black Milk Quartz.
217. Lamellar green Fossil.
218. Tourmaline, in Quartz.

153. *Killangarsuk.* 154. *Karosulik.*

155. *Ravöe.* 156. *Iglorsoib Ikaresak.*

219. Granite, with Hornblende (153).
220. Garnets, in Mica Slate.
221. Epidote.
222. Asbestiform Tremolithe.
223. Molybdenite, in Lamellæ.
224. Actinolithe, with yellow Mica.

157. *Kariabkingoa.* 158. *Kariat.* (*Continent.*)

White Granite, with Mica Slate alternating.
225. Iridescent Adular, in beds.
226. Asbestus.
227. Amianthus, with Rhombspar.
228. Brown Mica, traversed by Amianthus.
229. Amianthus, with Talc.
230. Glassy Actinolithe (Diallage).
231. Olivine, mixed with Mica.
232. Olivine, in loose grains.
233. Molybdenite.
234. Red Amianthus.

159. *Alliortok.* (*Island.*)

Granite, the constituent rock.
235. Allanite, in Granite.
236. Milk Quartz, in veins.
237. Pearl-blue Adular.
238. Labrador Felspar.
239. Sahlite, massive, ironshot.
240. Sahlite, in six-sided prisms.
241. Anthophyllite.
242. Black Mica, in tables.
243. Granular Olivine.

160. *Narksak.* (*Continent.*)

Granite, alternating with Mica Slate.
244. Basalt, in veins, traversing Granite.
245. Titanite, in Quartz, Felspar, and Sahlite.
246. Sahlite, in four and six-sided prisms.
247. Molybdenite, in Granite.
248. Scapolithe, in prisms.
249. Milk Quartz.
250. Felspar, crystallized.
251. Garnet, with Quartz and Felspar.
252. Epidote, in four-sided prisms.
253. Allanite, of a brownish-green colour, in Granite.
254. Black Allanite, in Granite.
255. Garnets, in Granite.
256. Meadow Iron-ore, in loose pieces.

161. *Pikkiudlek.* **162.** *Ekallungoak.*
163. *Mountain Innuksursoak.* **164.** *Kassigiongoit.* (*Bay.*)

Coarse, granular, white Granite predominating rock.
257. Allanite, in Granite.
258. Precious Garnet, in Mica Slate.
259. Emerald, in rounded boulders.
260. Garnet-like Mineral, in Granite.
261. Mica, in six-sided tables, traversed by Amianthus.

165. *Ikerdlek.* **166.** *Ekalluit.*
167. *Kitingursak.* **168.** *Killaersarbik.*

Fine and coarse granular Granite.
262. Allanite, in Granite.
263. Titanite, with Moroxite.
264. Magnetic Iron-sand, with Quartz and Garnet.

169. *Tongmeraglik.* **170.** *Auaitsirksarbik.*

265. Whitestone.
266. Mica Slate.
267. Aumaursak, or foliated precious Garnet.
268. Labradoric Hornblende.
269. Lamellar Augite.
270. Rose-red Quartz, in beds.
271. Milk Quartz, in beds.
272. White substance, in four-sided Prisms.

171. *Nouga.* **172.** *Oriartarbik.*

273. Talc, with Iron Pyrites.
274. Common Actinolithe.
275. Milk Quarz.
276. Talcose Rock, with grains of Felspar.

173. *Kikertangoak.* (*Island.*)

Coarse granular Granite, the predominant rock.
277. Garnet, in Whitestone.
278. Pargasite, in calcareous Spar.
279–284. Cubical Iron Pyrites, loose, in Clay.

174. *Itarurtikæt.* **175.** *Kakelak.*
176. *Niksik.* **177.** *Itiblirsoak.*
178. *Niakornak.* **179.** *Nunangitsok.*
180. *Akajaminek.*

285. Grey Granite, the constituent rock.
286. Glassy Actinolithe.
287. Brown Garnet, in Quartz.
288. Siliceous Stalactite.
289. Yellow vitriolic Stalactite.

181. *Quanneit.* **182.** *Karosulik.*

Fine, granular, grey Granite.
290. Talcose Mica Slate (in beds).
291. Moroxite, in Mica Slate.
292. Tourmaline, in Mica Slate.
293. Quartz, with Mica.
224. Indigolithe, with Quartz.
295. Rhombspar.
296. White Felspar.
297–305. Loose Crystals of Tourmaline.

183. *Nunangiæt.* (*Continent.*)

Syenite, constituent rock.
306. Mica Slate.
307. Garnet, with Labradoric Hornblende.
308. Hornblende, with Garnets.
309. Labradoric Hornblende.
310. Grey Quartz.

184. *Niviangamæt, Tuapaksoit, Itivinga.*
185. *Tuapaksangoit.* (*Continent.*)

Syenite.
311. Common Hornblende.
312. Milk Quartz.

186. *Kingiktorsoak, or Iliortetakken.* (*Continent.*)

Grey, fine, granular Granite.
313. Asbestiform Anthophyllite.
314. Glassy Anthophyllite.
315. Green Mica, with decomposed Felspar.
316. Moroxite, in Granite.

187. *Kangerdluarsungoak.* **188.** *Ukusiksät.*

Coarse and fine granular Granite.
317. Indurated Talc.
318. Bluish-grey Quartz.
319. Brown ironshot Sand.

189. *Kikertarsoak, Rypoe.* **190.** *Kikertarsoak, Ravnöe.*

Coarse granular Granite.
320. Rock Crystals, in groups.
321. Common Quartz, in pyramids.

191. *New Herrnhut.* (*Settlement of the Moravian Brethren.*)

Coarse, granular red Granite, constituent rock.
322. Scapolithe, in Gneiss, from the Ship's Haven.

193. *Stachs Ware.*

323. Reddish-white Milk Quartz.
Green Felspar, in fragments.

194. *Godthaab, or Nouk, Noyme.* (*Danish Settlement.*)

Coarse and fine, granular, red Granite.
324. Axestone, in boulders.
325. Glassy Actinolithe.
326. Calcedony, in fragments.

192. *Thorhallesens Vare.*

327. Milk Quartz.
328. Whitish-grey Adularia, loose.
329. Allanite, in red Granite.
330. Singular Hornstone.

Baal's River.

195. *Iglorpeit.* **196.** *Kanglerdluluk.*
197. *Kematulliecat.* **198.** *Ekallungeit.*
199. *Nepiseat.* **200.** *Kikertarsuksuarak.*
201. *Makkarsusuk.* **202.** *Akunek.*

Grey, fine, granular Granite, in a long chain.
331. Tourmaline, with Garnet in Granite, from Akunek.

204. *Angakik.* **205.** *Makkak.*

332. Bluish-grey sandy Clay.

206. *Illuvilek.* **207.** *Kaneitsut.* **208.** *Sarlok.*

Fine, granular, grey Granite.

209. *Kaniorsoit.*

Coarse granular Granite.
333. Opalising Adularia, with black Mica.
334. Ditto, with Garnet, Schorl, and Quartz.
335. Milk Quartz.

210. *Kognersoak.*

Mica Slate.
336. Tremolith, in Mica Slate.
337. Micaceous compound.

a. Rooksut.

211. *Auppadlartok.*

338. Impressions of the Salmo Arcticus, in Clay.

212. *Tessersarsoit.*

339. Augite? with Felspar?
340. Sahlite, with Quartz.

213. *Killangeit.* 214. *Itivinga.*

341. Talc formation.
342. Asbestiform Actinolithe, with Talc.
343. Hornstone-like Quartz.
344. Glassy Actinolithe.

215. *Tessiursak Bay.* (*Continent.*)

345. Common Actinolithe.
346. Indurated Talc.
347. Grey Hornstone, with Iron Pyrites.

b. Illulielik.

216. *Iglorsoit.*

348. Yellowish-grey Potstone.

c. Ujararsoak.

217. *Nougarsuk.*

349. Almandine, in Mica Slate.

218. *Naviangoit.*

350. Singular greyish-green compound of a rock.
351. Common Tremolithe.
352. Glassy Actinolithe.

d. Kangersunæt.

219. *Narksoitsiak.*

Grey Granite the predominant rock.
353. Black Mica, with common Actinolithe.
354. Glassy Actinolithe.
355. Indurated Talc.
356. Bluish-green indurated Talc.

[ADDENDUM.—I hope shortly to publish an account of the Greenland Minerals brought home by Sir Leopold M'Clintock, and in the meantime avail myself of Mr. . W. Tayler's kindness in giving me information respecting mineral localities in Greenland by publishing the following letter.—ED.]:—

"27, *Burton Crescent, February* 28, 1861.

"DEAR SIR,—Our mutual friend, Sir Leopold M'Clintock, has sent me a list of Greenland Minerals collected by Giesecké, and wishes me to write to you concerning them. I have not visited nearly so many localities as Giesecké, and can only give you information of the minerals found by me and others, mostly in the western districts. The most interesting new localities are:—

46. *Sardlock.*—Fergusonite, Titanic Iron, Beryl; in coarse-grained granite.
56. *Itiolik.*—It is questionable if the sandstone is the Old Red.
59. Gieseckite cannot now be found: it is supposed that the wrong locality has been given; it has been searched for repeatedly, without success.
62. *Julianshaab.*—A piece of rolled Phosphate of Lead, found in transported gravel.
96. *Nanaitiak*, an island close to Nunarsoit.—Variegated Copper, in chloritic schist; Amazon Stone.
111. *Ivikaet*, or *Ivigtout*, or *Evigtok.*—Tantalite, in fine crystals; a new hydrous silicate of Zirconia and Yttria; Fluor; Blende; Auriferous Arsenical Pyrites; Galena, containing 58 ozs. silver to the ton.
116. Allanite, Potstone.
117. "
118. "
120. The Greenlanders say that large bones are to be found high up on this mountain.

126.⎫ Copper Pyrites; Hypersthene.
187.⎭ Glacial mud, Silex and Alumina.

Avigait, near 187.—Much Allanite.

Selenide of Lead and Copper, from the neighbourhood of Godhaab.

"These are the most interesting things I can remember at present.

"I am, dear Sir, yours truly,

"J. W. TAYLER.

"*Rev. S. Haughton, F. T. C. D.*"

XXVII.—Remarkable Discoveries in Central Australia. By John Locke, M. R. D. S.

(Plate XII.)

[Read before the Royal Dublin Society, March 18, 1861.]

A letter to our secretary, Dr. Steele, from the Hon. John T. Bagot, Crown Lands' Commissioner at Adelaide, and a corresponding member of this Society, intimating the success of an expedition into the interior of Australia, was received early in February; and the next Australian mail brought the journal and map of route of the adventurous traveller, Mr. John M'Douall Stuart, a native of Ulster—one of that self-denying and philanthropic band, which enrols the names of Bruce, Cooke, Leichhardt, Livingstone, and many others, who have conferred upon the British Empire, and upon mankind through its instrumentality, benefits infinitely more valuable than the triumphs of war; and the fruits of whose labours generations to come are destined to reap, while the world lasts, in the reproductive appropriation of regions, practically boundless in extent, and exhaustless in resources. The superficial area of Australia is scarcely one-fifth less than Europe; and of this two million square miles, or nearly two-thirds of the whole, remained intact and unknown, until Mr. Stuart planted the British flag in the centre of the continent. The arrival of his journal, published, with an admirably written prefatory article, in the "South Australian Advertiser," enables me to gratify Mr. Bagot's desire, in laying before the Society a brief sketch of the results of the expedition, with such reflections as have occurred to mind, while tracing the annals of previous discovery in those far-withdrawn and hitherto unknown regions. My information is unavoidably incomplete; but before our session of this year closes, an opportunity may happily occur for laying before you more full and particular statements; for tidings arrived this very day from Adelaide, that Stuart had started again on New Year's Day, with the determination to accomplish the transit to the Gulf of Carpentaria during the Australian summer months; so that we may fairly expect information of his success before the end of May. He was furnished with twelve men, forty horses, and ample supplies, by the Colonial Government. The expedition, which forms the subject for consideration this evening, comprised only two men and thirteen horses, and was fitted out at the cost of Messrs. James Chambers and William Finke, wealthy Adelaide merchants, who, we trust, may live to witness the legitimate results of their munificence and sagacity, in the rapidly progressive prosperity of a colony, that boasts such public-spirited citizens.

The longest and most remarkable exploratory journeys, previous to Stuart's, were those of Eyre, Leichhardt, Gregory, and Sturt. Eyre, in 1836–7, traversed the southern coast country from Port Lincoln to

King George's Sound, and thence to Perth, on the Swan River, an interval of more than twenty degrees of longitude; and along his whole course did not cross the catchment basin of any considerable stream flowing seaward. In 1844–5, the intrepid and enterprising Leichhardt (whose fate is still a mystery, having never returned from a subsequent expedition), penetrated in a N. W. direction from Moreton Bay to Port Essington, a distance of some 1800 miles, a large proportion of which, especially in the districts E. and S. E. of the Carpentarian Gulf, lay through fertile, pastoral, and well-watered uplands. However, though his track must have crossed almost within sight of Stuart's furthest north, the interval remained unexplored, and thus was left unsolved the problem, that would have completed the supplement of the transcontinental route.

Gregory's exploring party, in 1856, travelled south, starting from the vicinity of the River Victoria in North Australia, until they attained latitude 18° 31′, longitude 130° 49′, on the border of a sandy desert extending beyond the range of vision. They then turned westward, still keeping this desert in view for 300 miles, until a series of depressions, the saline beds of dried-up lakes, in latitude 20° 16′, longitude 127° 35′, barred all further progress; and Gregory retraced his steps despondingly, under the impression, that vast barren tracts in the interior formed an impassable barrier between the northern coast and the great settlements of Southern and Eastern Australia. However be it borne in mind, that Gregory, in proceeding westward, turned his back on Stuart's subsequent route through a diversified but practicable country; while, on the other hand, Stuart's furthest north overlapped the southern limit of the other by some score miles.

But a still more important expedition, in relation to our present subject, is that of Sturt in 1844–5, who started from the banks of the Darling, about five degrees to the eastward of Stuart's starting point, with the intention of reaching the Gulf of Carpentaria by a north-westerly route; but having attained latitude 24° 30′, longitude 138°, fear of the approaching droughts, and the weakness of his party, compelled him to return. We are accustomed to look for examples of valour to the battlefield—of fortitude, to the unshaken resolve of the patriot; and find a difficulty in realizing to imagination the courage, determination, aye and philanthropic feelings too, that inspire the ardent votary of discovery in his perilous journeys by land or sea. Sturt thus describes, with a noble and touching pathos, the disappointment of his just ambition:—" A veil hung over Central Australia, that could neither be pierced nor raised. Men of undoubted energy and perseverance had tried, in vain, to work their way to that shrouded spot—girt round about by deserts, it almost appeared as if Nature had intentionally closed it upon civilized man, that there might be at least one domain on the Earth's wide field, over which the savage might roam in freedom. . . . . . . And to him, who had well nigh reached the topmost step of the ladder, whose hand had all but grasped the pinnacle, how great must be the necessity, how severe the struggle of feeling, that forces

him to bear back and abandon his task."* Again, how sincerely can we sympathise with the mingled aspirations and regret of the lonely sojourner, as prophetic anticipations of the success of some happier explorer cheer the weariness of hope deferred throughout the long unvaried lapse of sunlight hours, or while the watches of the night pass silently over his heavy eyelids in the wilderness. Such were, doubtless, Sturt's reflections, when he says:—"There may yet be that in the womb of time, which shall repay me for all I suffered in the performance of this dreary task—when I shall have it in my power to say, that I so far led the way across the continent, as to make the remainder of comparatively easy attainment; and, under the guidance and blessing of Providence, have been mainly instrumental in establishing a line of communication between its northern and southern coasts. I see no reason to despair, that such may one day be the case."†

Truly, the noble example of such a leader could not be fruitless; and it may be, that these very words furnished incentive to the subsequent expedition; for one of the companions of Sturt in travel, his tried and trusty friend in many a weary hour, was John M'Douall Stuart.

On the 2nd of March, 1860, Mr. Stuart started from Chambers' Creek, situated on the outskirts of the settled districts, about 500 miles N. W. from Adelaide, latitude 29° 30′, longitude 137°. His journal is brief, and barren in scientific details, or romantic incidents of flood and field, the smallness of the party rendering it impossible to collect accurate scientific information, or bring away many specimens of the natural history of the districts through which he passed; however, the geographical features of his route were carefully observed, and have been delineated on charts; and the practicability of colonising the central and intervening districts appears to be satisfactorily demonstrated by the fact, that during the entire transit across eleven degrees of latitude there was danger only on a single occasion from want of water, and that during one short interval of sixty miles.

The physical structure of the interior, as indicated by the strata of the hill ranges, which seldom exceeded 1000 feet in elevation, usually consisted of granite, gneiss, hematite, and quartz. Volcanoes there were none, though traces of ancient igneous action were not unfrequent; and in one locality only, latitude 22° 33′, longitude 133°, did he discover any indication of a valuable mineral deposit—copper ores, superficially shown, and in considerably quantity.

Many new plants and birds were observed, and several curious varieties of the gum-tree, in all their evergreen, or, rather *never-green* luxuriance; for the Australian Flora in but few instances displays the verdurous tints of our evergreen foliage—the leaf colour of the ubiquitous gum-tree especially exhibiting what one might call a dundukuddy-mud-colour green. Mr. Stuart notes among the grasses a species, which he designates wild oats, four feet in height, and others bearing a marked

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* Sturt's "Narrative," vol. ii., c. 1. †Vol. ii., c. 3.

similitude to wheat and rye. It would be strange, indeed, if the mystery of the origin of the cereals was destined to be solved in this region of so many anomalies, both in its flora and fauna. A singular and beautiful tree, conjectured by Mr. Bagot to be the Baobab, is, I rather think, that species of Capparis, described and figured by Grey in his tour through N. W. Australia.* The Baobab (or rather Bahobab, *Adansonia digitata*), is only met within a limited district in Western Africa.

The hill ranges, mounts, creeks, and springs, Mr. Stuart has named after distinguished travellers, colonial statesmen, and eminent merchants of Adelaide, thus discreetly exercising (I venture to affirm) the privilege of discovery, in preferring to immortalise his friends and Australian Notabilities, than in retaining native designations for sake of euphony (as some have deprecatingly urged), where not a trace of derivative or traditionary interest attaches. And, truly, the euphony is very problematical. There is no accounting for tastes; but Higgledy-piggledy, to my ear, sounds just as musical as Munducki, or Hullabaloo as Burraburra.

On the 22nd of April Mr. Stuart camped in the centre of Australia, and built a cone of stones upon the summit of a hill in the immediate vicinity, which he named Central Mount Stuart. On the top of the cone he placed a small bottle, with a slip of paper therein, noting names and date, and planted the British ensign in the centre. Then, having given three hearty cheers for

> "The flag that braved a thousand years,
> The battle and the breeze,"

our travellers resumed their route, still keeping a N. W. direction, until on 26th June they reached latitude 18° 57″, longitude 134°; when, while Stuart was examining the country from the summit of a hill, in expectation of discovering some clue to a watershed towards the Gulf of Carpentaria, he was attacked by a large party of natives with great fury and determination. These were fired upon, and completely routed; but Stuart deemed it imprudent to attempt a further advance in the face of such fearful odds, and retraced his steps to Chambers' Creek, which he reached in safety on the 3rd of September, after an absence of exactly six months on his perilous enterprise,—having travelled, allowing for circuitous direction and the various angular detours from the main track, little short of 2000 miles, or about eleven miles per day.

The incident of the attack I give in his own words:—

"Tuesday, June 26.—Large gum creek, with sheets of water. I have resolved to follow this creek down to-day, and if water continues, to follow it out; so started on a course 77°, and at six miles crossed the creek, it running a little more to the north; long sheets of water all the way down to the banks; at some places are steep. The lower part formed concrete; the upper part is sandy soil, which gives me a bad opinion of it for water if the concrete ceases. Here we saw some blacks;

* Vol. i., c. 6.

they would not come near us, but walked off as fast as they could. From the top of the rise we saw where they camped, which was on the banks of large sheets of water; we passed them without taking any notice, and at nine miles, not seeing any appearance of the creek, changed my course to 25°. At three quarters of a mile cut it again, but with no water in it; it is much narrower and deeper, having sandy banks and sandy bed, with gum-trees growing in the bottom. Changed again to 77°, frequently crossing the course, and at fifteen miles saw there was no hope of obtaining water. The country is becoming more sandy, with spinifex and thick scrub, down to the banks of the creek. I must keep close to the hills, and as the day has been very hot, I shall return and camp at nine miles from our last camp, if there is water; if there is not, I shall have to camp a short way above where we saw the natives this morning. I do not wish to get too near them, nor amongst them in any way. We could find no water below where they were camped; I therefore pushed on to get above them before dark. At about 1 o'clock, thirty miles from the creek, we saw where they had been examining our tracks; and as we approached the creek their tracks became more numerous on ours. When we arrived on the top of the rise, from where we had previously seen their fires, we now saw neither smoke, fires, nor anything else, it being nearly dark. I concluded they had left in consequence of having seen us pass in the morning. I was moving on to the place where we crossed the creek in the morning, and had just entered some scrub, when suddenly up started three tall, powerful men, fully armed, having a number of boomerangs, waddies, and spears; their distance from us being about 200 yards; it being also near dark, and the scrub we were then in being very disadvantageous for us, I wished to pass them without taking any notice of them; but such was not their intention, as they continued to approach us, calling out, and making all sorts of gestures, apparently of defiance. I then faced them, making all sorts of signs of friendship I could think of. They seemed to be in a great fury, moving their boomerangs about their heads, and howling to the top of their voices, also performing some sort of dance. They were now joined by a number more, which in a few minutes increased to upwards of thirty—every bush seemed to produce a man. Putting the horses on towards the creek, and placing ourselves between them and the natives, I told the men to get their guns ready, for I could see they were determined upon mischief. They paid no regard to all the signs of friendship I kept constantly making, but were still gradually approaching nearer. I felt very unwilling to fire upon them, and continued making signs of peace and friendship, but all to no purpose. An old man (the leader), who was in advance, made signs with his boomerang for us to be off, which proved to be one of defiance; for I had no sooner turned my horse's head to see if that was what they wished, than we received a shower of boomerangs, accompanied by a fearful yell; they then commenced jumping, dancing, yelling, and showing their arms in all sorts of postures, like so many fiends, and setting fire to the grass. I could now see many others getting up from behind the bushes.

Still I felt unwilling to fire upon them, and tried to make them understand that we wished to do them no harm; they now came within forty yards of us, and again made a charge, throwing their boomerangs, which came whistling and whizzing past our ears. One spear struck my horse. I then gave orders to fire, which stayed their mad career for a little. Our pack-horses, which were before us, took fright when they heard the firing and fearful yelling, and made off for the creek. Seeing the blacks running from bush to bush, with the intention of cutting us off from them, while those in front were still yelling, throwing their boomerangs, and coming nearer to us, gave them another reception, and sent Ben after the horses, to drive them to a more favourable place, while Keckwick and I remained to cover our rear. We soon got in advance of our enemies, but they still kept following, beyond the reach of our guns; the fearful yelling continuing, and fires springing in every direction; and it being now quite dark, with the country scrubby and our enemies numerous, bold, and daring, we could easily be surrounded and destroyed by such determined fellows as they have shown themselves to be. Seeing there was no chance with such fearful odds against us (ten to one), and knowing the disadvantages under which we laboured, I very unwillingly made up my mind to push on to last night's camp, which we did. I have considered the matter over, and I do not think it prudent to remain here to-night; I shall therefore continue my journey until reaching the open grassy plain on Gum Creek. They still keep following us. I only wish I had four other men; my party being so small, we can only fall back, and act on the defensive. If I were to stand, and fight them, our horses must remain unprotected, and we, in all probability, cut off from them, which they seem to be aiming at, and prevent our advance up the creek; by this time they must know that we do not care for them. Arrived at Hayward's Creek at 11 o'clock.

"Wednesday, June 27.—Hayward's Creek. Last night it was my intention to have gone this morning to Keckwick's Ponds to water the horses, given them this day to rest, and to have proceeded the next day back to the large creek, and go on to the distant hills that I was steering for on the 25th instant; but after considering the matter over, I have most reluctantly come to the determination of abandoning the attempt to make the Gulf of Carpentaria, as being most imprudent, situated as I am, and my party being too small to cope with such wily, determined natives as those we have just encountered. Their arrangements and manner of attack were as well conducted and planned as Europeans could do it. They observed us passing in the morning, and examined our tracts to see which way we had gone; knew we could get no water down the creek, and must return to get it, so thus must have planned their attack. Their charge was in double column, open order, and we had to take steady aim to make an impression. With such as these for enemies, it would be destruction to all my party for me to attempt to go on, and all the information of the interior that I have already obtained would be lost, having only half rations for six months (four of which are already gone), and my men complaining of weakness from

short rations, and unable to perform what they ought to do, and my health being so bad that I am scarcely able to sit in the saddle the whole day. After considering all these obstacles, I think it would be madness and folly to attempt and risk more. If my own life would be the only sacrifice, I would willingly give it to accomplish the end I aimed at, but it seems I am not to attain it. Man proposes, but God disposes; and His will must be obeyed."

The difficulties of travel in the interior may be enumerated under four heads—drought; opposition of the Blacks; impracticable nature of scrub; and want of vegetable food. The two last mentioned can scarcely be deemed serious obstacles to a well-organised expedition, with time and plentiful resources at disposal. A sufficiency of preserved vegetables and fresh meats, preventive of scurvy, may be easily supplied; and a more careful examination, and discriminative appropriation of native vegetable productions would doubtless be found of service. The mernong, or native parsnip, also a kind of cucumber, and sundry other plants, some entirely new, are enumerated as agreeable and nutritious; and a plant of the Arum family, found at Neale's Creek in great quantities, is described as a most grateful remedy. The *Eucalyptus dumosus*, or wild tea-tree, might perhaps be added to the list; and the fruit, seeds, and inspissated sap of several trees, especially of the gouty-stem tree, a species of capparis, which is almost as useful to the Australian natives as the palm to the South Sea Islander.

The scrub, consisting principally of mulga, acacias, spinifex, and the haka, or saltbush, was found very troublesome to the travellers, tearing their clothes, provision bags, leather trunks, and cattle harness, and impeding their horses, who with difficulty were often forced to face it. The Australian scrub, however, presents no impediment at all comparable to the density and thorny armour of the Indian jungles; and, as the soil always becomes firmer, and grass springs up wherever the scrub is observed to be withering and disappearing, Nature herself by this ameliorative process suggests the easiest mode of overcoming the obstacle, and at same time reclaiming the soil; i. e. by burning the scrub. The systematic introduction also of the camel, as the carrier through these tangled wastes, would obviate many difficulties—the endurance of drought, broad-cushioned feet upon the incoherent sands, and lofty stature, sustaining its burden above the dwarfed foliage, would render the employment of that animal an invaluable aid to Australian exploration.

Scarcity of water has hitherto proved the chief hindrance to attaining a knowledge of the interior, the peculiar physical features in reference to this subject being the general absence of true fluvial waters, or rivers disemboguing into the sea; the impermanency of surface water after the rains; infrequent appearance of wells or springs; and the occurrence of creeks (occasionally saline), as the disappearing streams of the interior are oddly designated by the colonists. Captain Sturt was of opinion, that the elevated ranges of Australia constituted the island summits of a vast archipelago in some previous geological era, and the

gradual elevation of the entire area, and subsequent evaporation of the sea-water left behind in what had been bays and channels, formed those saline depressions and absorbent sands that swallow up the creek waters, and in some parts bar all ingress into the interior.

It is of the utmost importance to ascertain how far this obstacle—the scarcity of potable water—is capable of being diminished or overcome. Mitchell, a most intelligent traveller, says of the Bogan in New South Wales (a deep, wide, and rapid river in the rainy season, dwindled to a series of shallow pools, far apart, in the droughts) that a single dam of simple and economical construction would retain the water for several miles. Now, here is one obvious remedy, applicable to many of the creeks as well as rivers; and it may be that the floods could thus be economically stored in the unsightly summer bed of the Torrens itself, with diverse and considerable beneficial results to the inhabitants of Adelaide and its suburban districts; and by such a construction also, as would effectually obviate the dangers of occasional heavy and sudden rain-falls. The settlers in the trans-Alpine pastoral tracts of New South Wales have of late years been making clumsy attempts to arrest the rain supplies by reservoirs of various descriptions, for preservation of their cattle in occasional droughts. But these ought to assume the magnitude of public engineering works, as we hope soon to witness more extensively in the great peninsula of India, where even the restoration of the tanks constructed by races far inferior to us in civilization, and which have lain in ruins for several centuries, would restore its pristine fertility to many an impoverished district, and tend to secure on a sound basis both Indian revenue and Imperial ascendancy—for the yoke of a master, who expends income in employing reproductive labour at fairly remunerative wages, is always light[a].

In some districts the quantity of rain-fall nearly equals the tropical monsoons. Strzelecki observed on one occasion at Sydney, and that not specially remarkable, a fall of 25 inches in the twenty-four hours. In the tracts traversed by Stuart, however, no portion of the rain is carried seaward,—all the water being gathered in isolated basins, or within the catchment of creeks, or percolating through the sandy soil into the natural reservoirs of the substrata. Now, may not these buried stores be made in many instances easily and cheaply available, by means of careful observation, aided by a little applied knowledge of practical geology? Stuart's journal of April 22nd, when he stood a triumphant discoverer in the centre of the continent, states, that being

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[a] Irrigation—not only by immense works of canalization, such as Alexander the Great beheld with wonder in Babylonia, or as we now witness in China, but also by storing the seasonal rains, and turning to economic account the continuous small contributions of rivulets, fountains, and springs—was remarkably exemplified in the primitive civilization of both hemispheres; but, under the exterminating influences of conquest and national decay, the lesson fell gradually into disuse and oblivion; and the once fertile champaigns of Mesopotamia, Peru, and many other climes of East and West, are now arid and treeless deserts.—*See* Porter's "Five Years in Damascus;" and Bowen's "Peru" in "Vacation Tourists," 1860.

in want of water, he procured it "*by scratching in the sand;*" and in most cases the wells or rather natural springs resorted to by the natives, indicated plentiful supply at greater depths. I do not mean to recommend the expensive process of boring Artesian wells, as practised by the French in Algerian deserts; but a comparatively shallow screen of arid surface is frequently found to preserve, as well as to conceal, an inexhaustible reservoir of supply; and such disclosure too might be made a more potent means of conciliating the jealous aboriginal tribes, than any other expedient whatsoever. I may here introduce, in illustration, an example, far distant indeed in time, but not far-fetched in appropriateness. The desert tracts, east of Zaele, in Syria, constituted in the era of the earlier Roman Emperors the principal granary for growth of corn, for consumption not only of their own then abundant population, but also of the teeming millions in the kingdoms or pro-consulates of Judea and Western Syria; but the chief source of this extraordinary productiveness was the substratal water drawn from wells; and, though now the district is a barren wilderness, yet the very same source of fertility is there, inviting the investment of industry. Water is everywhere found, at a depth varying from five to twelve feet. Burckhardt and other later travellers attest this fact; and the late James Silk Buckingham assured me of the same, not only in this district, but in other Oriental deserts. The impermanency therefore of surface water only implies, that it will be found beneath, sometimes with little labour, and often in unexpected quantity.

Again, the occurrence of occasional waterless wastes does not necessitate the total abandonment of colonizing schemes. Sturt, Leichhardt, and Stuart, all traversed many districts of great extent and fertility, abounding in springs and streams; and such, even though separated by intervening desert spaces, might form a chain of oases from Adelaide to the Carpentarian Gulf—certainly a novel, but by no means an improbable condition of colonization[a].

Two incidental proofs, curiously confirmatory of the existence of habitable central regions, may be here mentioned. 1st. The migration of birds in countless numbers to the N.W. from the country north of Lake Torrens. 2nd. That the tribes at opposite points of the coast bear closer resemblance to each other in physical characteristics and customs, than to those tribes separated from them by wide intervals of shoreward deserts; plainly intimating the fact of frequented lines of communication through the central country. It is suggestive also of the same fact, with what rapidity any scrap of news—a wreck, or a traveller's visit—is conveyed to opposite points of the coast, from tribe to tribe of the scattered nomadic population.

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[a] Had Stuart's Expedition included a dozen families, with their domiciliary stuff and cattle, and sufficient grain to overlap a second harvest, the immediate initiation of a prosperous colony, in many of the interior districts traversed, might have been accomplished without difficulty.

But in this, as in other analogous instances of exploratory enterprises, hostility of the natives will probably be found the most embarrassing obstacle to forming the nucleus of any settlement. The Aborigines are a branch of the Papuans, or Oriental Negroes, and the most degraded of that savage race. The partial civilization held by their progenitors, and from which these untaught children of the wilderness gradually lapsed, must have been very remote; for they have no idea of a Supreme Being; no memorials, nor rude sculptures; no tradition, nor traditionary rites; with perhaps one exception, the practice of circumcision by a few of the tribes, and with them indeed a very curious, though unmeaning custom; for no significance is ascribed to it; and it is performed with such injudicious severity, as to impair, and sometimes altogether destroy the generative vigour*. Naked and houseless, their existence is a perpetual struggle with the powers of unsubjected nature; the use of fire seems almost the only indication of intelligence with the most degraded, though a few of the tribes exhibit a somewhat superior physical and mental development. Stuart relates, with comic seriousness, one amusing instance of supposed native intelligence:—

"Saturday, June 23.—Keckwick's Ponds. Resting horses. About 10 o'clock were visited by two natives, who presented us with four opossums and a number of small parrots. They were much frightened at first, but after a short time became very bold, and wished to steal everything they could lay their fingers on. I caught one concealing the rasp used in shoeing horses under the netting he had round his waist, and was obliged to take it from him by force. The canteens they seemed determined to have, and it was with trouble we could keep them away. They wanted to pry into everything, and it was with difficulty we could keep them off. In about half an hour two other young men approached the camp. Thinking they might be in want of water, and afraid to come to it on account of the horses, I sent Ben with a tin-dishful, which they drank. They were very young men, and much frightened, and would not come near. About an hour before sundown the first that came returned, bringing with them three others. Two were powerful, tall, good-looking young men, and as fine ones as I have yet seen. They had a hat or helmet on their heads, which looked very neat—fitted close to the brow, rising straight up to a rounded peak, three or four inches above the head, and gradually narrower towards the back part. The outside is net-work; the inside is composed of feathers, very tightly bound with cord until it is as hard as a piece of wood. It may be used as a protection against the sun, or armour for the battle-field. One of them had a great many scars upon him, and seemed to be a leading man. Two only had helmets on; the others had pieces of netting bound round their foreheads. One was an old man, and seemed to be the father of the two young men. He was very talkative, but I could make nothing of him. I endeavoured to obtain from him where the next water is by

* Funditus etiam ad urethram ab infera penis parte.

signs, and so on. After talking some time, and he talking to his sons, he turned round and astonished me by giving me a masonic sign. I looked at him steadily. He repeated it, as did also his two sons. I returned it, which seemed to please them much. The old man then patted me on the shoulder, stroked my head, and all took their departure, making friendly signs, till out of sight."

Now I should guess, that some runaway convict, or profane wag of a sailor (and profane he assuredly was, to disclose the secret symbol) had taught this mimetic savage the signs of masonic recognition. There is no doubt indeed, that throughout the Oriental world there exist fragmentary indications of a mystic science of immemorial antiquity, more or less cognate to what we designate Freemasonry; but the mysticism of the Buddhist, or Parsee, would be utterly incommunicable to the understanding of a Papuan. At all events, in *this* instance the ostentation of the fraternal sign proved to be, as sometimes found among civilised Masons, a delusion and a snare; for only two days after the occurrence Stuart was attacked by a party, evidently well acquainted with his movements and resources, and forced to return without accomplishing his object of reaching the Gulf of Carpentaria.

Besides the higher regard of Christian obligation, the Aborigines must be viewed in the conventional aspect of British subjects, and as such entitled to protection; and I believe the Colonial Government and Police to be sincere in their desire to protect them. The Colonial blue-books attest but few instances of their cruel treatment, and these principally among the outlying settlers, the nomadic pioneers of colonization; who urge, in extenuation, series upon series of vexatious injuries, aggravated only by patient forbearance, and issuing at length in the wild justice of revengeful retaliation against the black fellows. The physical advantages of civilization, evidenced by the increasing comforts of the settlers, sometimes attract the adult savage to resign his roving habits, wear clothing, labour for hire, and dwell in a permanent habitation; but any extensive results in the change of moral character can only be expected from education of the young, in which lies the special mission of the Missionary and Evangelist. The gradual extinction of barbarous races dwelling in the proximity of civilization, like the process of eremacausis in the chemistry of nature—a wasting away without perceptible contact with any destroying agent—is a subject of sad but *unavailing* reflection[a]; for surely it is only an irrational and sickly sentimentalism, that would plead for the arrest of colonization, in order that the savage should roam in freedom unrestrained over the wide uncultured savanna, or through the tangled

[a] New Zealand presents one of the very few instances of a savage population not only surviving, but being reclaimed and improved by, the contact of the white man. But then the Maoris are of Malay origin, and vastly superior in frontal type and mental development to the Papuans of Australia. The contrast is more distinctly seen in contemplation of the fact, that the Tasmanian Papuans have totally disappeared, notwithstanding the diligent care to preserve the remnant of that miserable race.

mazes of primeval forests, feeding, like the omnivorous Australian, upon the flesh of kangaroos and wombats—when these fail, upon roots, grubs, and reptiles; and at last, in failure of these, or of water, perishing from sheer inanition, with a productive soil beneath his feet, and a salubrious heaven above. Now they alone can be said truly to possess the earth, who subdue it, pouring freely forth, as blood, the sweat of toil in the conflict: and thus applied labour in these neglected and unappropriated regions is providentially constituted the especial condition of ownership. That condition, once exhibited in its industrial realization for an example to barbarous tribes, establishes their responsibility; and if they despise the tenure of industry, and refuse to fall into the ranks of progress, they perish under the reflex action (so to speak) of the Divine injunction impressed upon the physical destiny of the human race (Genesis i. 28).

The lesson to be gleaned from Stuart's narrative, for instruction of future explorers in communication with the natives, is plain and important, in order to insure the success of discovery, and avoid the sacrifice of life. Fear alone is potent to overawe the suspicions and impulsive nature of those who cannot even comprehend, much less appreciate moral motives. They should be treated with justice, but with caution and reserve, never permitted to enter the camp; and any act of violence should receive summary and severe punishment.

It is a disheartening circumstance, that colonization has hitherto so disastrously failed in Northern Australia; yet it is hard to believe that Port Essington would have proved, under enlightened sanitary management, a less endurable climate than our settlements in Western Africa, or even than the city of palaces on the Ganges; but a northern settlement cannot be deemed a hopeless speculation, while the border lands of the Carpentarian Gulf remain in great part unexplored. Its geographical position, stretching far and wide into the continent, suggests the probability of its affording the chief outlet for drainage of the interior; and Leichhardt's journals, as before stated, attest the occurrence of extensive and well-watered pastoral uplands E. and S.E, of the gulf, with indications of a seaward water-shed. The vast arms of this gulf seem to invite to their embrace the commerce of Asia and the Oriental Archipelagos. The Dutch, Malayan, and Chinese traders regularly visit its shores for tortoise-shell, trepang, nacre, and other littoral products; and if once a safe portage and desirable site for a colony were fixed on, the elements of an extensive traffic would soon be developed; and the jealous exclusiveness of the Batavian Government, as well as the barbarous prejudices of the numerous insular populations between Australia and Singapore, would yield by degrees to the pressure of mutual wants and advantages.

Part of Northern and the whole of North-Eastern Australia, besides affording cattle pasturages and cereal lands of vast extent in the upland districts, possess also in the champaign-coast territory a soil and climate peculiarly suitable for the production of cotton and sugar, comprehending an area at least thrice the extent of the seceding section of the great

American Republic. It would be incompatible with the scope of this short paper to enter upon the consideration of comparative statistics; but whoever will take the trouble of tracing the rapid progress to prosperity of the Australian wool market will not be disinclined to admit the likelihood of successful cotton speculations in the new colony of Queensland*, as soon as an adequate importation of free labour warrants investment of capital; while, on the other hand, the colony of South Australia is more suitable for the culture of cereals and the vine.

Among the more immediate beneficial results of a habitable interior, would be the facility afforded for transit of horses, and other live stock, from the southern coasts to the Gulf of Carpentaria, for exportation to India, thus avoiding the dangerous, circuitous, and expensive sea passage. And there appears even now no obstacle of any importance to the erection of a telegraph from Adelaide to the Gulf, in order to facilitate communication with the parent country, and give renewed impetus to the prosperous progress of Victoria and South Australia—the most distant, yet not the least flourishing settlements of England's outer Empire. Certainly the obstacles, whether in respect to time, expense, or danger, are small in comparison with those experienced by our fellow-countryman, Sir William O'Shaughnessy, in connecting by the electric wire all the great capitals of India.

A few words in conclusion will not be inappropriate, as respects the general subject of colonization. This distributive agency, which appears to be the special mission of England, is now the most active power and peculiar characteristic of the world's progress, and constitutes the material basis of that moral strength, potent and instant in every region of the habitable sphere, to overawe tyranny, protect the weak, cherish the first awakening of popular freedom, and disseminate just principles of religious truth and public equity. In whatever corner of the globe the emigrant plants the standard of fatherland, England is in due process of time reproduced, by the impress of identity in intellectual and social character and municipal institutions; and this remark is more distinctively applicable to the Australian colonies, in consequence of their more unmixed British population.

In the last paper which I had the honour to read before this Society, commenting on the barren results of Polar research, I observed that "there are many extensive fertile regions in habitable climes as yet unexplored, save in isolated spots upon their boundaries, and that these presented the legitimate domain of discovery."* Now, I can happily substantiate the statement, by adducing the instance of this

* The reader will find in Lang's "Queensland" (Stanford, London, 1861), a fund of varied and most valuable information respecting this new colony.

The great interspace, bounded by the proposed western limit of Queensland, and by the interior boundary of Western Australia, I have ventured to designate Carpentaria, as a suggested new colony, having its capital on some one of the rivers on the western arm of the gulf, in a more central position than Port Essington.—See Map.

vast region, comprising so large a portion of the globe. Australia, the scantiest of all lands in natural productions suitable to the wants and habits of civilized man, is notwithstanding the most manageable, the most prolific—in a word, the most utilitarian in its adaptability for introduced products. The domesticated animals, the food plants, the textile and dye plants, fruits, grasses, tea, tobacco, the sugar-cane, the mulberry, and the vine—the productions of all climates flourish in Australia; and there also is the supplement of a complete prosperity, in the three remaining requisites, of unlimited space, general salubrity, and exclusive ownership, in a continent removed by the breadth of a hemisphere from the conflicts and perils of all the other nations of the earth. No hostile ship has ever entered the roadstead of Port Philip. There are no heights of Abraham frowning above the broad thoroughfares of Sydney, a district covered with houses, where within the memory of living men was seen only the perishable hut of the wandering savage. What shall be the future of Australia, at this rate of progress, is rather the province of an ardent imagination to picture, than of statistical science to calculate. Sure am I, that were the united empire of the British Islands destined to be blotted from the map of Europe by the ruthless arm of conquest, or the more gradual sap of national decay, Australia would arise, an antipodal England, to transmit, entire and untarnished, her religion and institutions—the same banner of liberty would be unfurled beneath the Southern Cross as now beneath the Polar Star; and the inscript on that banner might well be, in memory of ancestorial glory, that motto, which the Royal Dublin Society has so long worn, and so justly earned—

"Nostri terra plena laboris."

XXVIII.—On the Shower of Aeroliths that fell at Killeter, County of Tyrone, on the 29th April, 1844. By the Rev. Samuel Haughton, F. R. S., Fellow of Trinity College, Dublin.

[Read before the Royal Irish Academy, April 22, 1861].

On the 29th April, 1844, a shower of meteoric stones fell, in the sight of several people, at Killeter, near Castlederg, Co. Tyrone; they broke into small fragments by the fall, one piece only being found entire. It was (according to the testimony of a resident) "about as long as a joint of a little finger." The account given by three gentlemen, who, however, did not actually see the shower fall, was that they were at a distance of three or four miles, up the hills in the neighbourhood; it was a fine sunny evening, three or four o'clock. They heard "music" towards Killeter, which they supposed to proceed from a strolling German band, which they knew to be in the neighbourhood; they are under the impression that they heard the music several times in the course of the evening; they remember also to have noticed clouds in the direction of Killeter. On reaching Killeter the same evening, they were told of the wonderful shower of stones, which had spread over several fields. I received the fragments of these stones from the Rev. Dr. M'Ivor, ex-Fellow of Trinity College, Dublin, and rector of Ardstraw; he writes to me that "it is now very difficult to get either a specimen of a stone or any very distinct intelligence of them; even the very rumour of them has nearly died out, and you might ask intelligent middle-aged men about the neighbourhood who had never heard them mentioned." He adds that the people of that locality are very "uncurious;" and that if there were a veritable burning bush thereabouts, few would "turn aside to see."

The largest specimen given to me by Dr. M'Ivor weighed 22·23 grs. in air, and 16·32 grs. in water, showing that its specific gravity is 3·761. It and the smaller fragments presented the usual black crust, and internal greyish-white crystalline structure and appearance, with specks of metallic lustre, occasioned by the iron and nickel alloy that was present. I analysed it in the usual manner; but, owing to an accident, I was unable to determine the composition of the earthy portion soluble in muriatic acid.

The following is the mineralogical composition of these aëroliths:—

1. Hornblendic mineral, (Insoluble in acid).	34·18
2. Earthy mineral, (Soluble in acid).	30·42
3. Iron,	25.14
4. Nickel,	1·42
5. Sesquioxide of chrome,	2·70
6. Cobalt,	Trace
7. Magnetic pyrites,	6·14
	100·00

The earthy portion insoluble in muriatic acid had the following composition:—

		Atoms.	
Silica, . . .	55·01	1·22	
Alumina, . .	5·35	0·10	
Protoxide of iron,	12·18	0·34	
Lime, ...	3·41	0·12	1·66
Magnesia, . . .	24·03	1·20	
	99.98		

Omitting the alumina, the preceding analysis gives the rational formula of the Hornblende family

$$4RO, 3SiO_3;$$

and taken as a whole, it agrees with the analysis of many Hornblendes —the variety of Hornblende with which it has the closest relation is Anthophyllite.

According to Mr. Greg's catalogue of meteoric stones and irons, three other falls of aërolitbs are recorded as having occurred in Ireland:—

a. A. D. 1779; at Pettiswood, Westmeath; 6 oz.
b. August, 1810; Tipperary; 7¾ lbs.
c. 10th Sept. 1813, Adare, Co. Limerick; 17 lbs. + 65lbs. + 24lbs. Moving E. to W. sp. gr. = 3.64.
d. 29th April, 1844, Killeter, Co. Tyrone; fragments of one stone sp. gr. = 3·761.

XXIX.—On the Connexion between Storms and Vertical Disturbances of the Atmosphere. By Professor Hennessy, F. R. S.

[Read before the Royal Irish Academy, May 13, 1861.]

Storms are now fully recognized to result from antecedent abnormal physical conditions of the atmosphere. The contact of unequally dense and elastic masses of air usually precedes every kind of storm. These disturbing conditions are themselves dependent chiefly on inequalities of temperature and dryness in the aërial strata. Were we able to observe these physical conditions simultaneously over a wide surface, and vertically in ascending over several points of an extensive district, we should be able to predict a coming storm from the observed conditions, quite as securely as a physician can prognosticate the ultimate results, by studying the symptoms of some well-known and frequently-recurring malady. But it is extremely difficult to observe the atmosphere in the manner thus indicated. The barometer presents manifestations of the physical state of the entire column of air situated vertically over it; and although such indications are limited in their character, they are those on which we

are obliged principally to rely. Rapid changes in atmospheric pressure in any locality, as well as unequal simultaneous pressures in places but little apart, are now regarded as very frequent precursors of storms; but if we inquire into the causes of such inequalities of pressure, we shall find that other indications of atmospherical disturbances may be expected.

When two masses of air of unequal density are in contact, the tendency towards equilibrium will not be so immediate or so simple as most writers on the theory of winds appear to assume. Resisting forces of various kinds exist, among which some arise out of the friction of the currents among themselves, and against terrestrial objects; but the most important will result whenever it happens that the less dense mass of air possesses greater elasticity than the denser mass. Instable equilibrium may thus exist for a short time before either of the two masses could give way; but while such a state of comparative equilibrium temporarily subsists between the two great masses, minor disturbances will arise wherever their strata came into immediate contact. The mingling of the heterogeneous strata will take place, as in all fluids, by a process of convection.

I have already shown the important influence exercised by this process in the mode of heating of the atmosphere, and I have attempted to point out its relations with the most ordinary horizontal and vertical movements of the air.* In order to observe such movements, I devised a species of vane, which shows the existence of an upward or downward motion in the air, as well as the horizontal direction of the wind. When the air is still, or moving parallel to the earth's surface, the vane shows no upward or downward inclination. In the presence of two great heterogeneous masses of air, yet in a state of instable equilibrium, we would usually not have any indications of the convections of their particles, except the occasional ascent of light objects from the ground, or the sudden indraught of smoke in chimneys. But such phenomena are necessarily vague. If we are entitled to assume that much vertical convection of the air, with comparatively little horizontal motion, foreshadows an approaching disturbance, it follows that a better mode of observing vertical currents is desirable. During the three winter months, I have been occasionally observing vertical currents of the atmosphere, with the aid of such a vane; my observations have not been made at fixed hours, nor on every day; but they have usually arisen whenever abnormal disturbances occurred. As a general rule, I have found that most of the storms which we experienced during the past winter have been preceded by violent vertical movements of the atmosphere. In most of those cases, downward currents appeared to prevail. During the fine weather at the close of January, I observed so little of vertical currents, that I laid aside my journal; but on the two days preceding the disastrous storm of Saturday, February 9, some circumstances attracted my

* "Reports of the British Association for 1858;" "Atlantis," No. V.; and "Philosophical Magazine" for May, 1860.

attention, and induced me to resume my observations. On the 7th, I observed, at about 4 P. M., in a part of a wide street, bordered only by a wall, a gentleman's hat lifted off his head to a height of at least five feet. The hat dropped back again, without being transferred horizontally to any appreciable extent. On Friday, the 8th, at 2 in the afternoon, my attention was called to the anemoscope, by its shifting round, through N., towards N. E., with decided and frequent downward plunges. It appeared as if showers of cold air were descending;* the temperature was also falling. At this time the horizontal motion of the air was comparatively little, while the vertical convection was apparently highly developed. Next day, during the storm, the disk of the vane was in a state of constant oscillation; but no marked prevalence of upward or downward motions could be observed, and nothing resembling the plunges noticed on the preceding day.

Although we should scarcely expect to be able to observe the influence of such disturbances in a mercurial barometer, they may become manifest, were we to use a liquid column of much greater height.† During the short period that a column of water was so employed by Professor Daniell at the apartments of the Royal Society, he appears to have noticed numerous and rapid oscillations during storms. The diminution of such oscillations, both in frequency and intensity, enabled him to predict the approach of fine weather. During windy weather, the regular and continuous motion of the water-column resembled the action of respiration. This remark corresponds with what I have stated, both here and elsewhere, as to the oscillations of the anemoscope during gales of wind. The inference which I drew from the comparative regularity of such oscillations is, not that vertical currents prevail with strong winds, but that the motion of the air is essentially undulatory. The irregular and plunging motions of the air observed by me before storms, and sometimes even before rain, are essentially different phenomena, and they do not appear to have been noticed by Mr. Daniell in any of the appearances exhibited by his water-barometer.

One of the most remarkable phenomena connected with the storm of the 9th February was the rise of the barometer a short time before its commencement. A fall had taken place at a preceding period; and, in accordance with the usual empirical rules, the rise would be considered as showing the approach of fine weather; but when this rise was accompanied by northerly and easterly winds, and when the air at the surface of the earth was becoming mingled with cooler particles descending from above, it is manifest that the increased pressure was due to the increase

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* Dove refers to the precipitation of cold air during whirlwinds, and to the storm assuming the form called by the Greeks εκνεφίας.—"Board of Trade Meteorological Papers," No. III., p. 22; and "Taylor's Scientific Memoirs," vol. iii., p. 215.

† In extraordinary cases the mercurial barometer has always exhibited such fluctuations: thus Dove refers to a remark of Hoskiaer, that during the great hurricane of August, 1837, at St. Thomas, the mercury sank two lines at each gust, and then immediately rose to the same height as before.

of density of the entire aërial column over the barometer resulting from these influences. Thus the change from a high to a low density of the air was necessarily accompanied by convection between the warmer and cooler strata, as exhibited by the anemoscope.

Before, as well as during north-easterly storms, we may thus expect precipitation of cold air downwards, and ascent of warm air upwards. During a gale it becomes difficult to distinguish these phenomena from the merely oscillatory movements impressed upon the lower strata of the atmosphere by the influence of terrestrial impediments. When a shallow current of water passes over a rough bottom, it assumes a ridged surface. If we superimpose additional water, the surface of the current will become gradually smooth, and it may ultimately present no sensible inequality, as on the surface of a deep stream; but we cannot conclude that the oscillatory action of the particles near the bottom has been entirely extinguished. The influence of the obstacles upon the motion of the current will decrease in approaching the surface, and increase in approaching the bottom.

Thus horizontal currents of air, close to the earth's surface, are necessarily disturbed by the presence of trees, buildings, and other obstacles, and in this manner they may influence the movements of a vertical vane precisely in the way that has been observed. During a storm an observed diminution of vertical oscillations of the vane will result from diminished violence of the wind, just as the gradual lessening of the movements of the water-barometer seemed to Professor Daniell to foreshadow the cessation of a gale. During comparatively calm weather, very energetic vertical movements of the atmosphere may be safely grouped among the most certain symptoms of approaching disturbances on a grander scale.

XXX.—Annual Address, delivered before the Geological Society of Dublin, February 6, 1861. By the Rev. Samuel Haughton, F. R. S., President of the Society.

Gentlemen,—Since I last addressed you from this chair, a year of unusual scientific activity has passed, during which a large number of papers of more than usual interest have been communicated to the world by means of this Society. In a city like Dublin, possessed of so many aids to scientific research, a healthy competition exists among the various scientific societies; and I think I may congratulate the members of the Geological Society on the fact that we have not lagged behind in the race during the past year. We have had read before us during that period eighteen geological papers of more or less interest, but all possessing some feature of original thought or research that renders them worthy of preservation in the pages of our Journal. It would be impossible for me to do justice to all in so large a number; but I shall endeavour to bring out some of the more important features of a few, referring you for details to the papers themselves, or to your recollection of them, as read before us.

The following list contains the titles of these papers:—Descriptive Geology and Palæontology; 1. Sir Richard Griffith, "On the Stratigraphical Divisions of the Irish Carboniferous Series, as exhibited in the local tables, prepared according to fossiliferous arrangement, in reference to the Geological Map of Ireland;" 2. Mr. William H. Baily, "On Corynepteris, a new generic form of fossil fern;" 3. Mr. John Kelly, "On the Greywacke Rocks of Ireland, as compared with those of England;" 4. Messrs. Brownrigge and Cooke, "On the Geology of the Coast of the County of Waterford;" 5. Mr. Stanley, "On Faults in the Drift of the Central Counties of Ireland;" 6. Professor Jukes, "Geological Notes of a Tour in Switzerland;" 7. Dr. J. R. Kinahan, "On the Zoological Affinities of the Genus Oldhamia;" 8. The President, "On a new Fossil Plant from the Yellow Sandstone of the County of Donegal." Physical Geology and Mineralogy:—1. Mr. Robert H. Scott, "On a new Metallic Ore from the Connorree Mines, County of Wicklow;" 2. Mr. Alphonse Gages, "On the formation of Orpiment in a mass of Sulphate of Barytes, near Silvermines, County of Tipperary;" 3. Mr. A. B. Wynne, "On the Mining District of Silvermines, County of Tipperary;" 4. Dr. Aquilla Smith, "On the Pyrognostic Characters of Minerals, with a new arrangement of those usually found in Ireland;" 5. Mr. George M'Dowell, "On the Wolfhill and Modubeagh Collieries, Queen's County;" 6. The President, "On the Mineral Resources of the Estate of the Provost of Trinity College, near Maum, County of Galway;" 7. Dr. Apjohn, "On two associated Minerals from Ross Hill, on the northern shore of Lough Corrib;" 8. Mr. Patrick Ganly, "On the Past Intensity of Sunlight, as indicated by Geological Phenomena;" 9. Mr. Mahon, "On the Qualifications and Duties of the Mineral Agent;" 10. The President, "On the occurrence of Oligoclase in the County of Donegal."

I believe it would be difficult to overrate the value of Sir Richard Griffith's important paper, either in a scientific or historical point of view. It records with minute precision the fossils, the identification of which by M'Coy formed the basis on which the Geological Map of Ireland was founded, and it possesses a high value as a record of the state of Irish Palæontology at the time at which it was written—a value which, in my opinion, is only second to that which it must always have from its own intrinsic merit, and from the labour and intelligence bestowed upon it. Of Mr. Kelly's paper "On the Greywacke Rocks of Ireland and England," I would observe that it is essentially a criticism of the Silurian system of Murchison, from an Irish point of view. Its ability and vigour do credit to its author, and constitute a merit which must be recognised even by those who differ from the conclusions deduced by Mr. Kelly from his comparison of the Irish and English Silurian rocks. It is known to you that some difference of opinion existed as to the publication of this paper, on the ground that it was a geological heresy to differ in opinion with the distinguished inventor of the Silurian System. The Council of the Society thought it best to allow Mr. Kelly's paper to be printed, inasmuch as the author of a paper alone can be considered responsible for the statements made and inferences drawn in

it; and, under those circumstances, neither the Council nor the Society itself could be considered as adopting Mr. Kelly's views. Those views must stand or fall on their own merits; and, for my own part, I must confess that, though I differ from him, I believe his paper, by the free spirit of inquiry which pervades it, and the vigour with which it is written, does him no discredit, and is worthy of a place in the "Journal of the Geological Society of Dublin." One of the most striking features of the labours of our Society during the past year is the number of papers bearing on the development of the mineral resources of Ireland which have been laid before us. Of the eighteen papers I have before alluded to, no less than seven relate to mining districts or mining operations in various parts of the country. This fact appears to me to give us an additional claim on the support of our countrymen, as it shows we are as ready to turn our attention to the practical applications as to the theoretical speculations of the science we profess to cultivate. The most important of these mining papers is that laid before us by Mr. Mahon, who is already favourably known by his publications on the mines of Wicklow. It contains much information, partly original, and never before published, and partly concisely compiled from the newest and most authentic sources. It is the intention of the Council to print the first portion of this paper in our Journal, and also to publish it, with its valuable appendices, in a separate form, so as to make it known as widely as possible among those interested in developing in a legitimate manner the mineral wealth of the country. At our December meeting, Dr. Apjohn laid before us a highly interesting description of a mineral found associated with metallic ores at Rosshill, county of Galway. He believes it to be Damourite, now for the first time described as occurring in Ireland, and, like the original mineral of Delesse, associated with Andalusite, or Kyanite. Dr. Apjohn's account of this mineral is a veritable monograph, and will form a most interesting addition to our Journal. Mr. A. B. Wynne, of the Geological Survey, has contributed to our proceedings an excellent account of a mining district, that of Silvermines, county of Tipperary, which I can state, from personal knowledge of the district, to be exceedingly accurate and carefully drawn up. He has also illustrated it by a map of his own execution, which reflects much credit upon his skill as a draughtsman. Mr. Gages has taken occasion, from the occurrence of orpiment in a mass of sulphate of barytes, from the same mining locality, to bring under our notice one of his numerous interesting and original experiments, which throws some light on the obscure problem of the mode of formation of the various contents of our mineral veins. His experiments on this subject have been published in our Journal. Mr. Robert H. Scott has analysed, and brought before us, a mineral ore, occurring at Connorree mines, under circumstances similar to those under which a similar ore, described by Dr. Apjohn, in 1851, was found at Ballymurtagh mine, on the other side of the Ovoca. These ores, though similar in respect to the occurrence of sulphuret of zinc in both, associated with the protosulphuret of iron, differ with regard to sulphuret of lead, which was found by Dr. Apjohn to be present to a large amount,

while it was totally absent from the ore described by Mr. Scott, who considers his mineral to be a mixture of iron Pyrites and the Marmatite of Boussingault. Dr. Aquilla Smith has permitted me to lay before this Society some of his valuable mineralogical notes, founded principally on the pyrognostic classification and properties of minerals. The first part of these notes has been already laid before you, but I hope before the next anniversary meeting to be able to complete the series, which will form one of the most valuable and important additions to mineralogical science ever made in this country. I would take this opportunity of expressing, in the name of the Society, the obligations we are under to him for having permitted us to be the medium of communicating his mineralogical and pyrognostic ideas to the world. Mr. Baily's paper on a new genus of fossil fern, from the coal-measures of Glin, county of Limerick, with its excellent plate, forms an interesting addition to our palæontological papers. Dr. Kinahan has completed his researches on the Oldhamias of Bray Head, by the discovery of additional specimens, in better preservation than those previously found by him, and which enable him to speak with more precision than he was before able to do as to the true zoological relations of these curious fossils. This paper of Dr. Kinahan's has not yet been printed, and in this respect is in the same position as several other valuable communications to the Society. We hope from the unusually satisfactory Report of the Treasurer and Council, as to our financial condition, to be able, during the coming year, to publish all our arrears of printing; but this can only be done with prudence by the exertions of our members in procuring new members, and so increasing the pecuniary resources of our Society. The influx of valuable papers on various subjects of physical and descriptive geology, which has occurred during the past year, is mainly owing to our previous exertions in printing and circulating our Journal, which is now well known in all quarters of Europe and America in which the universal science of geology is studied. Although our connexion with the "Natural History Review" has ceased, yet the advantages we gained by it will be continued to us, as stated in the Report of Council, by the new connexion we have formed with the "Dublin Quarterly Journal of Science." The circulation insured to papers read before the Society in future will be the following:—

1. Members of the Society, ...	150
2. Exchanges with other Scientific Societies, . .	100
3. European and American Libraries, by means of the "Dublin Quarterly Journal of Science," .	150
4. Additional circulation of the "Dublin Quarterly Journal of Science" by sale, ...	100
Total, ...	500

The addition of about fifty to our list of members, which it is not unreasonable to hope for, would leave us in a most satisfactory condition as to our finances, and as to the publication of our Journal, which is the

most important end of our existence as a Society. Owing to the liberality of Trinity College, and of our valued member, Dr. Lloyd, we are enabled to dispense with house rent, while the transfer of our Museum to the University has improved and extended the facilities for studying geology in this city to an extent that could not have been effected by a small Society, struggling to maintain its ground under the threefold burden of house rent, cost of a museum, and the publication of its scientific proceedings. Experience has shown that there is not sufficient zeal for science in Dublin to support a society incumbered with these three objects. The Geological Society of Dublin, by getting rid of the first two burdens, and devoting its whole energies to the single object of publishing rapidly and as fully as possible the papers contributed to its meetings, has succeeded in attaining the respectable position which it now holds, and which it will improve and maintain among the scientific societies of Dublin. We owe the gratifying position we hold partly to the hospitality of Trinity College, and partly to the zeal and activity of our own members. Neither of these causes of prosperity is likely to fail us, and I therefore feel little hesitation in predicting our continued future success.

The Geological Survey of Ireland, under the management of our ex-President and Secretary, Mr. J. B. Jukes, has made considerable progress during the year, "the number of sheets of the one-inch Map, now complete, being 87, out of the 205 into which Ireland is divided. Explanatory descriptions of 26 of these sheets have been published, and several more are in the press. There have been also published 8 sheets of longitudinal sections, three cutting across the Queen's County and Kilkenny coal-fields, two across the anticlinals and synclinals of the county of Cork, and one containing a section from Cork harbour over the Galtees, and across the great Slieve-na-Muck fault of 4,000 feet (the grandest proved fault in the world), and connecting Cork with the Limerick district; also two sections across the singular trappean basin of the county of Limerick, with the Ballyhood coal-measures in its centre, and regular bands of bedded trap and limestone coming out all round, with intrusive bosses, and the old pipes and funnels outside that again."

Among the labours of members of our Socity, I would also mention the valuable "Analytical Report on the Metallic Ores of Southern India, exhibited at Madras in 1859," by Captain C. P. Molony, of the Madras Army, published in Madras in 1860. It contains a considerable amount of valuable information, not previously collected, as to the iron and lead ores of Southern India, which there can be no doubt, under proper management, would prove highly remunerative to skilled capitalists.

In a paper read before you in January last, I have placed on record the occurrence of oligoclase felspar, found by me in the syenite of Horn Head, county of Donegal. This syenite is composed of Oligoclase and Hornblende, and forms an interesting addition to our list of Irish rocks. On that occasion I made some observations on the manner in which oligoclase occurs in the granites of Sweden and Norway, in contact with quartz, and sometimes containing particles and veins of this quartz im-

bedded in its very substance. This appears to me to be a strong reason, in addition to those which I laid before you in my last Address, against considering granite to be simply an igneous rock, the product of fusion or dry heat. If such were the case, it would be impossible to explain why Oligoclase, melted in presence of molten silica, should not pass at once into the condition of Orthoclase; and indeed, from the limited knowledge I possess of the subject, I am disposed to believe that Orthoclase and Albite, in granite, indicate a higher temperature and more perfect fusion than Oligoclase does. I had intended to have laid before you on this occasion my views in detail on the subject of the origin of granite; but defer doing so until I have completed the investigations I have entered upon with regard to the igneous rocks of the Mourne Mountains. I hope on a future occasion to explain my ideas on this subject, and shall now ask your attention for a short time to a theory of configuration of land and water, and of the mountain chains and ocean valleys of the globe, that has appeared to me for some time to possess much probability and verisimilitude. I have frequently expressed the opinion that the changes of the globe consequent on its original fluidity had but little influence on geological phenomena. These astronomical changes of the globe, resulting from its secular cooling, determined the form and conditions of its seas and lands, long before it was fit for the habitation of any living creature; and I believe that the traces of this original crumpling of the earth's surface are still to be found in the distribution of its mountain chains and sea valleys. As the earth's surface cooled, it contracted upon the liquid interior, by the reaction of which, being incompressible, it was ultimately rent into certain fissures, elevated above the general surface, through which flowed the molten glass that afterwards, when metamorphosed by the action of water, became granite, and subsequently the trappean lavas. These fissures of elevation had a meridional direction, from north to south; and between them lay, as a matter of necessity, deep valleys of depression, into which the aqueous atmosphere of the globe was distilled on cooling. The existence of those meridional lines of fissure or elevation and depression is mathematically demonstrable from the conditions of cooling of a body shaped as the earth is; and these meridional lines of fissures were afterwards succeeded by transverse lines of elevation and depression in each hemisphere, following the line of small circles of latitude. Let us examine briefly, from this point of view, the structure of the present surface of the globe. Two irregularly-shaped valleys, but on the whole following a meridional course, traverse the surface of the earth from pole to pole. One of these, the Atlantic valley, passes close along the east coast of Greenland, between that country and Iceland, and thence extends southward on the meridian of 20° W. to the South pole itself. This valley is divided in the North Atlantic by the "middle ground," containing the Azores, into two valleys, of which the western, though less straight, is somewhat the deeper of the two; while in the South Atlantic its course is more directly southern, and, from the little we know of it, both by soundings and tidal observations, it appears to

be considerably deeper than in the North Atlantic. The second meridional valley, starting from the south, keeps along the west coast of South America, in the meridian of 90° West, in a direction due south and north, in very deep water, so far as we can infer from the progress of the tidal wave. Having reached the equator, it is directed to the west of north along the coast of North America, and enters the polar basin through Behring's Straits, in the meridian of 170° W. These two great meridional valleys divide the globe into two lunes, one containing the continents of the Americas and Greenland, and the other containing the Great continent, Africa, Australia, and the large islands north of it.

These two portions of the earth's surface appear to me to have had their equilibrium destroyed by meridional fractures in a manner precisely similar, but inverted with regard to the northern and southern hemispheres in the two cases. Each lune of the globe may be regarded as an arch, having for buttresses the meridional lines of depression already noticed. These buttresses having given way, the whole arch has broken, but in a different manner in the northern and southern halves. An arch, or dome, may give way when its buttresses fail, either by the bursting up of the crown and falling in of the hips, or by the falling in of the crown and bursting up of the hips of the arch. Both these cases have occurred, as I conceive, in each of the two great divisions into which the meridional valleys divide the globe.

1. The Great Continent.—In the northern hemisphere this mass is bisected by the meridional chain (60° to 75° E.), extending from 7° N. to 77° N., containing the western Ghauts, the Bolor and Solimaun Ranges, the Ural Mountains, and Nova Zembla, through a distance of 4,200 geographical miles. This ridge of elevation I suppose to represent the bursting up of the crown of the arch. In the southern hemisphere, however, the other form of fracture has occurred. The crown of the arch has fallen in, as shown by the deep valley of the Indian Ocean lying between Africa and Australia,—a valley the depth of which, as indicated by the progress of the tidal wave, is comparable with that of the South Atlantic. On either side of this central valley the hips of the arch have burst up in the meridians of the Cape of Good Hope and Van Dieman's Land, forming the meridian chains of mountains of Africa and Australia. These meridional chains are nearly symmetrically situated with respect to the crown of the northern arch or meridian of Cape Comorin, that of the Cape of Good Hope lying 60° W., and that of the eastern meridional chain of Australia 65° to the east of the meridian. In the northern hemisphere a secondary fracture has taken place, which I shall presently consider, and which modifies the primary or meridional fracture.

2. The American Continents.—In America the southern arch of the lune has burst up its crown along the meridian of Cape Horn, forming the great chain of the Andes, which extends north and south for 3,900 geographical miles, and is in every respect the counterpart of the Ural and Solimaun chain of Asia. In the northern hemisphere, however, the other mode of fracture has taken place, the crown of the arch having fallen in, forming the depression occupied by Baffin's Bay, Hudson's Bay,

and the central lowlands of North America; while the haunches of the arch have burst up along the line of the Rocky Mountains and the chain of Greenland and the Alleghany Mountains. We have thus the two great masses of land on the globe constructed by the original fracture on the same plan, but reversed with regard to hemispheres, of the lunes of the globe in which they are placed.

The primary meridional fractures having occurred, the secondary fractures are to be explained on the principles of the equilibrium of a dome, and not of an arch. I regard the whole northern hemisphere as one dome, and the southern as another. In the northern hemisphere the centre of the dome has fallen in, forming a depression at the pole, or Arctic Basin, and the hips of the dome have burst up along the small circles of latitude lying between 35° and 46°. In the great continent this up-burst of the dome may be traced from the Pyrenees, through the Alps, Balkan, Anti-Taurus, Caucasus, El Burz, Hindoo Koosh, the Thian Shan, and Shan Garjan Mountains, to the city of Pekin, through a range of 150° of long., or 6,700 miles in length. This astonishing range of mountains continues with but little deviation along the parallel of 40° N., forming a striking contrast to the meridional chains which traverse great circles of the globe. It is also a very remarkable fact that the Snowy Mountains of North America (700 miles in length), which form the only east and west range in that continent, are found to run along the parallel of 41° N., which we have every reason to believe resulted from the simple mechanical principles influencing the fracture of the northern dome; and even in the bed of the Atlantic a shallow band (the proposed line of the French telegraph) crosses the ocean in the same parallel from the Newfoundland bank to the Pyrenees. In the Southern Hemisphere, on the contrary, the equilibrium of the dome has given way by the reversed process—the crown having burst up, forming the Antarctic Continent, and, the hips of the dome having sunk in, form the small circle of deep water 40° S., which is interrupted only twice; by New Zealand, and the southern prolongation of the Andes.

I do not mean to assert that the present valleys and lines of elevation were those of depression and elevation of the primeval crystal glass of the fractured crust of the original globe; but I do believe that the lines I have pointed out were originally, and have always been, lines of either elevation or depression, and have constituted alternately the axes of continents or the valleys of the ocean. In a flat-arched dome, like the crust of the earth, very slight modifications of external conditions would convert the lines of depression into lines of elevation, and *vice versa;* and though the limits of this Address do not permit me to enter into detail on this subject, I think sound geological reasons could be adduced in support of the views I have advanced, which are based simply on mechanical reasonings. Although we have good geological reasons for supposing that the present line of elevation in the parallel of 40° N. latitude took place during the period preceding the tertiary, yet there is abundant evidence to show that it took place along the line of an ancient fissure, through which was poured the granite glass, considered by M.

Durocher as the outer solidified layer of our globe. A specimen of the granite of Mount Blanc, taken by one of our members, Mr. Robert Reeves, from a peak only 500 feet below the summit, gave me the following composition:—

Silica,	72·96
Alumina,	14·00
Peroxide of Iron,	2·42
Lime,	1·12
Magnesia,	0·14
Protoxide of Iron,	0·38
Protoxide of Manganese,	0·40
Soda,	4·33
Potash,	4·47
	100·22

This granite is identical in composition with that of Leinster, or with the type granite of Durocher, forming the outward layer of the earth's crust, and was probably poured out along the line it now occupies ages before the tertiary period. The mention of this granite reminds me of a sacred debt we owe to Durocher, whose untimely death was announced to us at the same meeting at which we elected him one of our honorary members. He was best known to us by his brilliant though brief essay on Petrology, of which it has been well said that if it was a romance, it was that of a man of genius. Truly the dreams of such men are of more value than the waking thoughts of many who lead scientific opinion among us. Durocher was educated at the Polytechnic School, and having become an Engineer of Roads, Bridges, and Mines in the public service of France, ultimately was appointed Professor of the Faculty of Science at Rennes. He was devoted to the study of physical geology, and possessed most of those high qualities which have made his country and his countrymen, in politics the terror, and in science the admiration, of Europe. Ambitious and ardent in pursuit of his favourite study, he overworked himself, and his premature death has added another name to the too-long list of those whom the world has lost too soon. It is creditable to this city and college that his labours were early appreciated in it. His work on Comparative Petrology has formed for some years a portion of our course for Honors in Trinity College; and I have been informed by my friend Professor Sullivan that at the time the translation of Durocher's Petrology was published by M'Glashan and Gill, of this city, he had himself nearly completed a translation of the same work, intended for publication in the "Atlantis."

XXXI.—On the Blowpipe Characters of Minerals. By Aquilla Smith, M.D., Fellow of the King and Queen's College of Physicians in Ireland.

[Read before the Geological Society of Dublin, June 13, 1860, and edited by the President and Secretary.]

Acmite, bacillary (Th.* 479).—Rundemyr, Norway. Hardness nearly = 6·0; streak whitish. In the forceps fuses readily and quietly into a brilliant black globule. No water. With borax fuses very slowly, and tinges glass with iron.

Actinolite.—Glen Elg, Scotland. In the forceps fuses rather slowly into a dark green globule. No water. With borax emits a few bubbles, and fuses rather readily into a glass, coloured by iron while warm.

Actinolite, asbestiform.—Haytor, Devonshire. Fuses into a black globule, feebly magnetic. With borax slowly soluble.

Actinolite, glassy (Th. 196; Al.† 145).—Asbestos Strahlstein of Werner. Zillerthal, Tyrol. Hardness = 5·3. Streak white. In the forceps becomes whitish, and fuses quietly but slowly on the edge into a greyish bead, and a small fragment forms a globule with difficulty; in the inner flame it effervesces and intumesces much. No water. With borax it fuses rather slowly into a glass, coloured by iron while warm.

Æschynite.—Miask, Siberia. Hardness = about 5·5; yields with difficulty to the knife; streak pale yellow; translucent in the fragments; does not scratch glass. In the forceps intumesces suddenly, and becomes yellow; it then fuses into a dull iron-black globule, not magnetic. Contains a little water. With borax dissolves into a clear glass, slightly coloured by iron while warm. No manganese with nitre.

Note.—Could not detect titanium by fusing it with bisulphate of soda and adding tin.

Albin, crystallized (*Vide* **Apophyllite**). (Th. 352; Al. 130).—Aussig, Bohemia. Yields easily to the knife. In the forceps fuses on the surface slowly, with slight effervescence scarcely perceptible, into a rough blebby enamel, but does not form a bead. Contains much water. With borax effervesces at first, and fuses rather slowly into a colourless glass, which does not become opaque by flaming even when saturated; with acetate of cobalt becomes blue.

Allagite (*Vide* **Rhodonite**).—Schelenholz, in the Hartz. Hardness = 5·5; streak white. In the forceps fuses readily on the edge, with some effervescence, into a greyish blebby glass. No water. With borax emits some bubbles; dissolves slowly, and in the outer flame indicates manganese.

[**Allanite.**—In forceps fuses readily into a black bead; with borax dis-

* Outlines of Mineralogy, Geology, and Mineral Analysis. By Thomas Thomson, M.D. 2 vols. 8vo. London, 1836. The references are to vol. i.

† Manual of Mineralogy. By Robert Allan. 1 vol. 8vo. Edinburgh, 1834.

solves readily into a transparent bead coloured with iron; with salt of phosphorus fuses into a transparent bead coloured with iron; on adding nitre, the bead becomes semi-opaque when cold, pearl-grey colour.—ED.]

Allochroite (*Vide* **Garnet**). (Th. 147; Al. 201).—Virums Iron Works, near Drammen, Norway. Resists the knife. In the forceps fuses readily into a brilliant black globule, not magnetic. No water. With borax emits a few bubbles; and fuses rather slowly into a glass, coloured by iron.

Allophane (Th. 243; Al. 73).—Moldawa, Bannat. Of pale bluish-green colour. Yields easily to the knife; streak white. In the forceps becomes white; colours the flame behind the assay green for a long time; and, in a good blast, fuses on the edge into a white enamel. With cobalt it becomes blue. Contains much water. With borax effervesces a little at first; and dissolves rather readily into a clear glass of a pale blue colour when cold. Does not gelatinize in nitric acid. Mr. Allan says, "in acid it gelatinizes."

Alumina, Hydrated (*Vide* **Diaspore**; **Gibbsite**). (Th. 221; Al. 307).—Richmond in Massachusetts, N. America. Yields easily to the knife. In the forceps is infusible; becomes very white. Contains much water. Infusible with borax; with cobalt a beautiful blue. Extremely rare.

Amphibole, Foliated (*Vide* **Hornblende**). (Th. 198; Al. 145).—Arendahl, Norway. Hardness = 4·5. Streak greenish. In the forceps fuses readily into a shining black globule, not magnetic, with scarcely any effervescence. No water. In borax emits a few bubbles; colours the glass with iron; and dissolves rather slowly. No manganese.

Amphodelite (*Vide* **Anorthite**).—(Th. 269).—Lojo, Finland. Hardness about = 4·5; streak white. In the forceps it whitens and effervesces a little; some parts of it fuse more readily, and with more effervescence than others, into a white blebby bead, rendered transparent in a stronger heat. No water. With borax emits a few bubbles at first, and fuses slowly into a colourless glass. No manganese.

Analcime (Th. 337; Al. 115).—Downhill, Londonderry. Hardness about = 5·5; scarcely yields to the knife. In the forceps when gently heated it becomes white and opaque, and fuses rather slowly into a colourless globule, slightly vesicular. [Very fusible; glassy bead; flame indicates much soda.—ED.] Contains water. With borax dissolves rather slowly into a colourless glass. Does not gelatinize with nitric acid. It becomes so transparent when strongly heated with the borax, that it appears to dissolve quicker then it really does.

Anatase (*Vide* **Brookite**; **Rutile**). (Ph.* 253).—Dauphiné. Hardness = 5·3; streak white. In the forceps it is infusible. With borax it dissolves slowly; when a very small proportion is dissolved, the glass is transparent and colourless when warm, on cooling it becomes reddish amethyst colour by transmitted light, and muddy reddish by re-

* An Elementary Introduction to Mineralogy. By William Phillips. Fourth Edition, by Robert Allan. 1 vol. 8vo. London, 1837.

flected light; in the reducing flame it becomes opaque, and the reflected colour is darker when cold, and the transmitted colour has a bluer shade. It cannot be rendered colourless in the inner flame, like Brookite; a little nitre discharges the colour. With salt of phosphorus it dissolves with great difficulty; the glass is yellow while warm, pale amethyst colour when cold.

Anatase.—Wheal Virtuous Lady, Tavistock, Devonshire. Hardness = 5·0 –5·5; streak white. In the forceps infusible. With borax fuses rather readily, and appears as if coloured by iron in the oxidating flame; in the reducing flame it becomes brown; its transparency may be restored in the outer flame, and it becomes opaque by flaming.

Andalusite, massive (*Vide* **Chiastolite**). (Th. 231; Al. 164).—Lugduff mountain, near Luganure, County Wicklow. Resists the file; hardness about 7·5. In the forceps it is infusible, but becomes white; with nitrate of cobalt it becomes blue; and with borax it is nearly infusible.

Anorthite (*Vide* **Amphodelite**). (Th. 296; Al. 138).—Vesuvius. Brittle; resists the knife. In the forceps fuses on the edge into a very transparent glass; a small thin fragment may be fused into a globule. No water. With borax it fuses slowly into a colourless glass.

Anthophyllite (*Vide* **Hornblende**). (Th. 206; Al. 107).—Hardness about = 5·5; streak white. Fuses with some difficulty on the edge. No water. With borax fuses very slowly into a glass, coloured with iron.

Anthophyllite, lamellar (Th. 206; Al. 107).—Ujordlersoak, Buffin's Bay. Hardness = 5·5. Streak white. In the forceps fuses on the edge, with some intumescence and effervescence, into a greenish glaze; a small fragment forms a bead. No water. With borax emits a few bubbles, and fuses slowly into a glass coloured slightly by iron.

Antimony, nickeliferous sulphuret of.—Gozenbach, Siegen. Hardness = 5·0. Powder dark iron-grey. On charcoal it emits some white fumes, with slight pungent odour, and fuses readily into a black bead, not magnetic; it is brittle, and breaks with metallic lustre. This bead, fused with borax, colours it deep blue in the outer flame, and alloys with the platina wire, in the inner flame the blue colour is changed into a brownish amethyst shade.

Antimony, red (Ph. 347; Th. 87).—Hungary. Yields very easily to the knife, streak dark red. Heated on charcoal it fuses speedily into a black vitreous mass; emits fumes of sulphurous acid; is entirely volatilized; and deposits a white sublimate on the charcoal. Hydrosulphuret of ammonia added to the sublimate converts it into an orange-yellow colour.

Antimony, sulphuret of (Ph. 345, Th. 86).—Felsobanya, Hungary. Yields very easily to the knife. Streak dark grey. On charcoal fuses very readily into a black vitreous mass, emits fumes of sulphurous acid, and then deposits a white sublimate on the charcoal, and is entirely volatilized.

Antimony, sulphuret of, compact variegated.—Golderonach, near Bayreuth, Franconia. Decrepitates violently when heated; but when reduced to powder and moistened, it affords same pyrognostic character as the last.

Antimony, white (Ph. 348; Th. 83).—Very rare. Yields very easily to the knife. Heated on charcoal, it decrepitates a little; fuses speedily into a fluid globule; volatizes without odour, and deposits white sublimate. On the charcoal a drop of hydrosulphuret of ammonia added to the white sublimate converts it to an orange-yellow colour after a few minutes.

Apatite (*Vide* **Lime, Phosphate of**). (Th. 124; Al. 27).—Ehrenfreidersdorf, Saxony. In the forceps fuses with some difficulty on the edge. No water. With borax fuses very slowly into a colourless glass, which becomes opaque by flaming, when only a small quantity of the assay is dissolved.

[**Apatite.**—Dalkey. In the forceps infusible, glows brilliantly. With borax, dissolves slowly; bead clear in reducing flame, becomes opaque in the ordinary flame, and coloured by manganese.—Ed.]

Apophyllite (*Vide* **Albin**). (Th. 352; Al. 129).—Karartut, Disko Island, Greenland. Hardness about = 5·0. In the forceps, at a low heat, it becomes white, exfoliates, intumesces much, and fuses readily with effervescence into a blebby globule, colourless. Contains much water. With borax it effervesces at first, and fuses readily into a colourless glass, which, when saturated, I could not render opaque by flaming. Berzelius says it becomes opaque by flaming. With acetate of cobalt it melts into a blue glass; reduced to powder, it gelatinizes with nitric acid.

Arendalite (*Vide* **Epidote**). (Th. 364; Al. 150).—Arendal, Norway. Resists the knife. In the forceps intumesces and effervesces, and fuses into a scoria, which, in a strong heat, is converted into a shining black globule, not magnetic. Contains no water. With borax fuses readily into a glass coloured by iron.

Arragonite.—Kanniok, Greenland. Effervesces briskly with muriatic acid. In forceps does not fall to powder; infusible. No water. With borax dissolves speedily.

Arragonite, fibrous.—Cornwall. With nitrate of potash gives indication of manganese. Contains 1·03 per cent. of manganese.

Arragonite, macled (Th. 117; Al. 30).—Molina, Arragon, Spain. Effervesces briskly with muriatic acid. In the forceps it becomes white, falls to powder immediately on being heated, and is infusible. Contains no water. With borax it fuses speedily with much effervescence into a colourless glass, which becomes opaque by flaming if a larger portion be added.

Arsenic, native (Ph. 280; Th. 79).—Idria, Austria. Its fresh fracture presents a tin-white appearance, but it very soon tarnishes on exposure to the air. Hardness about = 3·5. Streak metallic. Heated on charcoal, it emits copious greyish fumes of strong arsenical odour, and is entirely volatilized.

Arsenic, red sulphuret of (*Vide* **Realgar**). (Ph. 281; Th. 81).—Tran-

sylvania? Soft, brittle. Streak orange-yellow. On charcoal it burns with a bluish flame; emits copious sulphureous fumes, and a slight odour of arsenic.

Arsenic, yellow sulphuret of (*Vide* **Orpiment**). (Ph. 283; Th. 82).—Transylvania. Very soft. Powder bright yellow. On charcoal it burns with a bluish flame, emits fumes of sulphurous acid, and is entirely volatilized.

Arsenical Iron (Ph. 213).—Faithleg, Waterford. Hardness = 6. On charcoal it emits copious arsenical fumes, and fuses readily into a magnetic bead.

Arsenical Iron (Ph. 213).—Haytor Mine, Devonshire. Yields with some difficulty to the knife. Hardness = 5·5. Heated on charcoal, it emits copious arsenical fumes, and melts into a shining porous gray globule, attracted by the magnet.

Arsenical Iron.—Johanngeorgenstadt, Saxony. Hardness about = 5·5; streak shining; powder greyish-black. On charcoal it very soon emits fumes of arsenic, and becomes magnetic; it forms a bead with difficulty, even in the forceps.

Arsenical Iron, massive.—Hardness = 5·5; streak greyish-black. On charcoal it emits arsenical fumes readily and copiously, and fuses into a dark grey irregular scoria, which is magnetic; and when transferred to the forceps, forms a bead with difficulty. Does the difficulty of forming a bead by fusion depend on its containing less sulphur than other specimens?

[**Asbestus** (*Vide* **Hornblende**).—In the forceps fuses readily into a yellow-coloured opaque bead, with a narrow neck. No water. With borax dissolves readily into a colourless transparent bead. With microcosmic salt dissolves slowly, and leaves no siliceous skeleton.—Ed.]

Asparagus Stone (*Vide* **Apatite**).

Augite, black (*Vide* **Pyroxene**). (Th. 190; Al. 143).—Arendahl, Norway. Hardness nearly = 5·0; streak greenish. In the forceps fuses rather readily into a black bead. No water. With borax very slowly soluble.

Augite, black.—Ersby Pargas, Finland. Hardness near = 5·0; streak white. In the forceps in the inner flame fuses on the surface into a dark green glass, and forms a bead very slowly. No water. With borax emits a few bubbles, colours the glass with iron, and is very slowly soluble.

Augite, white (*Vide* **Pyroxene**). (Th. 187).—United States. Hardness = 5·0. In the forceps effervesces and intumesces, and fuses readily into a colourless blebby globule. No water. With borax dissolves partly at first, and leaves a residue very slowly soluble.

[The Augites dissolve in borax somewhat more easily than the Hornblendes; and in the forceps show slight traces of soda.—Ed.]

Axinite (Th. 367; Al. 191).—Dauphine. Resists the knife. In the forceps it fuses readily, with much intumescence and effervescence, into a dark green shining globule. No water. With borax it breaks up and dissolves readily into a transparent glass, coloured by iron; with nitrate of potash it indicates the presence of manganese.

Barytes, crystallized carbonate of (Th. 101; Al. 47).—Cumberland. Effervesces feebly with nitric acid, unless when scraped, and is entirely soluble in it. In the forceps decrepitates, and fuses readily into a very fluid globule, transparent while hot, white and opaque when cold, and tinges the flame behind the assay pale greenish-yellow. With borax fuses rapidly, with effervescence, into a glass opaque when cold, if saturated with the assay.

Barytes, carbonate of (Th. 101; Al. 47).—Yorkshire. Does not effervesce with acid, unless when scraped. Hardness = 3·0. In the forceps fuses readily, *without decrepitation,* and in other respects its characters are the same as the preceding.

Barytes, sulphate of.—Hardness about = 3·5. In the forceps fuses quietly into an opaque bead, white. No water. With borax fuses quietly, and rather readily, into a colourless glass.

Barytes, sulphate of.—Does not effervesce with acid; decrepitates violently. Tinges the flame behind the assay greenish-yellow, and fuses into a white enamel. No water. With borax dissolves with continued effervescence. The effervescence with borax is probably due to the presence of some carbonate of barytes.

Barytes, sulphate of.—Glenmalure, Co. Wicklow. Does not decrepitate; fuses into a white enamel.

Barytes, sulphate of.—Isle of Sheppey. Decrepitates; colours the flame greenish-yellow; fuses into a white bead. With borax dissolves readily.

Barytes, sulphate of (Th. 103; Al. 48).—From Transylvania. Decrepitates very slightly.

Barytocalcite (of Brooke). (Th. 140; Al. 50).—Cumberland. Hardness = 3·5. Effervesces feebly with nitric acid. Decrepitates in the flame of a candle, and fuses with difficulty into a rough mass of a pale blueish-green colour. With borax effervesces much.

Barytocalcite.—Alston Moor, Cumberland. Effervesces with acid. Tinges the flame pale yellowish-green, and in a strong heat it glazes a little on the surface, and becomes pale bluish-green. With borax effervesces much, and dissolves speedily. See the latter part of Mr. Allan's observations on Barytocalcite.

Berthierite (Ph. 344; Th. 498).—Braunsdorf, near Freyberg, Saxony. Hardness about = 3·0, or 3·5; streak dark grey. Heated on charcoal, it fuses (but not so speedily as grey antimony), emits sulphurous acid fumes, deposits a white sublimate on the charcoal, and is not entirely volatilized. A dull black globule remains, which is attracted by the magnet; when broken, a fragment of this globule fused. With borax indicates iron.

Bismuth Cobalt ore (Ph. 287; Th. 534).—Bieber, Hesse. Hardness = 5·5; streak metallic, powder dark grey. Gently heated on charcoal, it emits small globules; and when the heat is increased, gives off arsenical fumes, and then fuses into a dark bead rather slowly, which is feebly magnetic. A portion of the roasted assay colours borax deep blue.

Bismuth, cupreous sulphuret of (Ph. 278).—Cornwall. Sectile, streak

tin-white. The instant it is heated, it emits white globules, sulphurous acid fumes, and, after intense roasting, a bead of pure copper; said to be found only at Wittichen.

Bismuth, native (Ph. 276; Th. 588).—St. Just, Cornwall. Sectile, streak shining. Heated on charcoal, it fuses instantly, and is entirely volatilized, depositing a yellowish sublimate on the charcoal; the colour of the sublimate is much darker while it is warm.

Bismuth, sulphuret of (Ph. 277; Th. 588).—Cornwall. Yields to the nail. Fuses readily; emits sulphurous acid smell, and is only partly volatilized; leaves a bead, which is magnetic.

Bismuth, sulphuret of (Ph. 277; Th. 589).—Lanescot Mine, Cornwall. Yields to the nail, powder dark grey, brittle. Heated on charcoal, it fuses readily into a bead, brilliant while warm, emits slight smell of sulphurous acid; is entirely volatilized, and deposits a sublimate, yellow while warm.

Blende (Ph. 371).—Luganure Mine, county of Wicklow. Hardness = 4·5. In the forceps decrepitates at first, and fuses on the edge. No water. With borax it is slowly soluble.

Bluespar (*Vide* **Lazulite**). (Th. 311).—Krieglach, Upper Styria. Yields with difficulty to the knife; streak white. In the forceps becomes white, and fuses on the edge, in a good heat, into a white enamel. Contains a trace of water. With borax effervesces a little at first, and fuses into a clear glass, slightly coloured by iron; with acetate of cobalt becomes deep blue.

Bole.—Benevenagh, Derry. Sectile, streak unaltered; marks paper faintly; does not adhere to the tongue; does not fall to pieces in water. In the forceps fuses rather readily, with slight effervescence into a dark greenish bead. Contains a good deal of water. With borax fuses rather slowly, and colours the glass with iron while warm.

Bole.—Giant's Causeway. Scratched by the nail, streak shining; marks paper strongly; adheres slightly to the tongue, and falls to pieces in water. In the forceps decrepitates, and in a good heat fuses on the edge into a black glass, not magnetic. Contains a good deal of water. With borax dissolves slowly; no manganese. Is Dr. Thompson's plinthite a variety of bole?

Bonsdorfite (Th. 278 and 323).—Bodenmais, Bavaria. Translucent; yields to the knife. Hardness about = 3·5; streak white. In the forceps fuses on the edge into a greyish glass. Contains some water. With borax fuses rather slowly into a transparent glass.

Boracite (Th. 161; Al. 194).—Lüneburg, Hanover. Resists the knife. In the forceps intumesces, effervesces, and colours the *flame green* behind the assay, then fuses into an opaque yellowish-white bead. No water. With borax fuses into a transparent bead, slightly coloured by iron.

Borosilicate of Lime (*Vide* **Datholite**) (Th. 144; Al. 111).—Nodobröe, near Arendahl, Norway. Rather hard; yields to the knife. In the forceps becomes white and opaque, and fuses readily, with slight intumescence and effervescence, into a transparent colourless glo-

bule, rather fluid, and tinges the flame behind the assay green. *This globule becomes opaque by flaming.* No water. With borax effervesces at first, and dissolves speedily into a colourless glass.

Botryolite (*Vide* **Datholite**). (Th. 144; Al. 111).—Arendahl, Norway. Yields rather easily to the knife. In the forceps becomes white; intumesces slightly; tinges the flame green behind the assay, and fuses very readily into a globule perfectly transparent and colourless. No water. With borax dissolves readily into a clear glass.

Bournonite (Ph. 352; Th. 624).—Kapnic, Transylvania. Yields easily to the knife; streak dark grey. On charcoal, if gently heated, it fuses very readily into a dark-coloured globule, brilliant while warm; deposits on the charcoal a white sublimate in small quantity; it then disengages white fumes, which have a weak smell of sulphurous acid. In a stronger heat, it deposits a yellowish coating on the charcoal; and if the dark-coloured bead be roasted for a considerable time, a small globule of pure copper will remain, which is not equal in size to one-fourth of the assay, so that it is volatile in large proportion. This specimen appears to me to contain very little antimony, certainly much less than analysts have generally found.

Breunnerite (Th. 180; Al. 38).—Zillerthal, Tyrol. About as hard as fluor-spar. Does not effervesce with muriatic acid, even when scraped. In the forceps becomes black and magnetic, and is infusible. No water. With borax effervesces, briskly at first, and fuses speedily into a glass coloured by iron.

Brewsterite (Th. 347; Al. 128).—Strontian, Scotland. In the forceps whitens, exfoliates, curls up, and fuses rather slowly into a colourless blebby glass. Contains water. Fuses very speedily with borax.

[**Bronzite** (*Vide* **Pyroxene**).—In the forceps fusible with great difficulty on the edges. Dissolves in borax, like Coccolite, into a bead coloured by iron.—Ed.]

Brookite (*Vide* **Anatase**; **Rutile**). (Ph. 256).—Resists the knife. Hardness = 7·0. In the forceps infusible. With borax it fuses very slowly; the glass is transparent while hot; when cold, it is brick-red by reflected light, and a reddish amethyst colour by transmitted light, according to the degree of oxidation; a minute proportion produces these effects; in the reducing flame it becomes transparent, and remains so when cold, and may be rendered opáque again by careful management of the flame; nitre destroys the amethyst colour. With salt of phosphorus it becomes opaque, but requires a very intense and prolonged heat to dissolve it; the glass is opaque while hot; then becomes transparent olive-green, then blackish; and when perfectly cold, an amethyst colour by transmitted light.

Bucholzite (*Vide* **Kyanite**). (Th. 234; Al. 204).—Chester, on the Delaware, near Philadelphia. About as hard as quartz. In the forceps infusible in the smallest fragments. Contains no water. Infusible with borax; with nitrate of cobalt it becomes pale blue.

Buntkupfererz (*Vide* **Purple Copper**), (Ph. 310; Th. 662).—Alten Mines, Finmark. Its characters are very similar to purple copper. It bubbles a little while flaming.

Bustamite (*Vide* **Rhodonite**). (Th. 518).—Mexico. Hardness = 6·0; streak white. In the forceps at a low heat it blackens, and fuses slowly into a brilliant black enamel, forming a bead with difficulty. A trace of moisture. With borax dissolves readily, with some effervescence, into a glass of a reddish-purple colour.

The greenish radiated part is of hardness = 6·0. In the forceps fuses readily into a transparent globule of a pale brown colour, and effervesces a little while fusing. A trace of moisture. With borax dissolves rather readily, with effervescence, into a glass of a deep amethyst colour.

Calaite (*Vide* **Turquoise**). (Th. 230; Al. 157).—Abdool Razakee Mine, Persia. Scarcely yields to the knife; streak white. In the forceps becomes brown, and tinges the flame green behind the assay, but it is infusible. Gives out much water. With borax fuses rather readily into a glass coloured by iron.

Calaite.—Delsnibz, Saxony. Hardness near = 5·0; streak white. In the forceps tinges the flame pale green; becomes white, and infusible. Contains a good deal of water. With borax dissolves not very readily.

Calamine, Botryoidal electric.—Nertschinsky, Siberia. Hardness = 4·5; streak white; effervesces with nitric acid, particularly if scraped. On charcoal it is infusible; in a low heat it cracks and becomes yellow; in a stronger heat, it becomes nearly black, and the charcoal is covered with a powder which is yellow while warm. No water. With borax it emits bubbles, and dissolves readily into a glass, yellow while warm, colourless when cold.

Cerite (Ph. 262; Th. 415).—Bastriaës, in Sweden.

Cerite. Hardness = 5·0; streak white. In the forceps scintillates a little, becomes pale buff-yellow, and is infusible. A trace of moisture. With borax it effervesces at first, and dissolves rather slowly into a glass, of a deep umber colour while warm, then passes into a pale green, and is nearly colourless when cold; the glass becomes milky by flaming, if a large proportion of the assay be used.

Cerine. Colour black, hardness = 5·0; streak greyish. In the forceps fuses rather readily, with slight ebullition, into a black shining glass, not attracted by the magnet. A trace of moisture. With borax it effervesces, and dissolves rather readily into a glass, reddish while hot; greenish, as if coloured by iron, when cold. It becomes opalescent by flaming when nearly saturated.

Chabasite (Th. 333; Al. 118).—Yields rather easily to the knife; streak white. In the forceps becomes white; intumesces much, and fuses with slight effervescence into a white blebby globule. Contains much water. With borax it dissolves speedily, with slight effervescence, into a colourless glass. Does not gelatinize in nitric acid, even when heated.

Chabasite.—North of Ireland. Yields easily to the knife. In the forceps becomes white; intumesces much; and fuses into a white blebby

bead. Contains much water. With borax effervesces a little, and dissolves readily.

Chalalite (*Vide* **Thomsonite**). (Th. 324).—Benevenagh, Derry. Resists the knife. Hardness about = 5·5; translucent on the edge. In the forceps fuses quietly, and rather readily, into a transparent, colourless bead, slightly blebby. Contains much water. With borax it fuses rather readily into a glass, slightly coloured by iron while warm, and leaves a small skeleton, which dissolves slowly.

Chalcolite (Ph. 270).—Wheal Bassett, near Gwennap, Cornwall. Hardness = 2·5–3·0; streak pale green. In the forceps becomes pale green, and fuses readily, with some ebullition and intumescence, into a black semi-vitreous globule; colours the flame pale green. Contains much water. With borax it dissolves readily into a glass, green by transmitted light, reddish by reflected light.

Chiastolite (*Vide* **Andalusite**). (Al. 160).—Hof Bayreuth, Germany. Sectile. In the forceps, at a low heat, it becomes dark grey, and in a stronger heat it becomes white, and fuses on the edge into a white blebby glass; with acetate of cobalt, fuses into a blue frit. Contains a good deal of water. With borax it dissolves slowly into a colourless glass.

Childrenite (Al. 39).—Tavistock, Devonshire. Hardness about = 4; powder white. In the forceps the crystals separate, become black, and fuse into a black globule, attracted strongly by the magnet. Contains water. With borax dissolves rather readily.

Chlorite.—Glandore, Co. Cork. Sectile; streak greenish. In the forceps partly falls to pieces, and fuses into a dull black globule, feebly magnetic. Trace of moisture. With borax effervesces at first, and fuses speedily into a glass, deeply coloured by iron.

Chlorite, crystallized.—Marazion, Cornwall. Sectile. In the forceps the laminæ diverge a little; it fuses quietly into a dull black magnetic bead. Some water. With borax it effervesces at first, and fuses speedily into a glass, coloured deeply by iron.

Chloropal.—Unghvar, Hungary. Yields to the nail. In the forceps it blackens, becomes magnetic, and is infusible. Contains a little water. With borax dissolves readily. No manganese.

Chondrodite (Th. 183; Al. 193).—Sussex County, New Jersey, North America. Hardness about = 4·5; streak white. Infusible. No water. With borax dissolves rather slowly into a glass coloured by iron while warm.

Chromate of Iron (Ph. 275; Th. 482).—Shetland. Hardness = 5: streak pale brown. Infusible; does not become magnetic. With borax dissolves very slowly, and colours the glass green; the intensity of the colour increases as the glass cools.

Chromiferous Iron Ore (Ph. 275).—Crogh Hay, Croaghpatrick mountain, Mayo. Streak pale brown. In the forceps infusible. A trace of moisture. With borax it dissolves slowly; the glass is coloured bottle-green while warm, and when cold it becomes rich grass-green. It is attracted freely by the magnet.

Chrysocolla (Ph. 322; Th. 619).—Oganoos, Chili. Translucent on the edge. Yields easily to the knife; streak nearly white. Does not effervesce with cold muriatic acid; partly soluble in warm muriatic acid, leaving a white residuum. In the forceps it blackens, and the flame behind the assay is coloured green; in a stronger heat it becomes a reddish-brown, and cracks on the surface, but does not fuse. Contains a good deal of water. With borax it fuses readily, with effervescence, into a glass, green while warm, blue when cold.

Cinnabar (Th. 634).—Idria, in Carniola. Hardness = 2·0; streak red. On charcoal it burns with a blue flame, emits the smell of sulphur, and is entirely volatilized.

Cinnabar, hepatic.—Idria, in Carniola. Hardness = 2·0; streak brown. On charcoal it emits slight smell of sulphur, and is volatilized, with the exception of a carbonaceous residue.

Cinnamon stone (*vide* **Garnet**). (Th. 265; Al. 201).—Colombo, Ceylon. Hardness about equal to quartz. In the forceps fuses rather easily into a translucent green bead, not magnetic. With borax it effervesces a little at first, and fuses rather slowly into a clear glass, faintly coloured by iron while warm.

Cobalt Bloom (Ph. 289; Th. 535).—Schneeberg, Saxony. Hardness = 2·5; streak nearly white. On charcoal, when first heated, it becomes blue, then fuses readily, with some arsenical odour, into a black bead, which in a stronger heat spreads on the charcoal, and forms a scoria, which is infusible. Contains much water. A minute portion of the scoria, fused with borax, colours it deep blue. In the open tube gives off water, but no sublimate.

Cobalt Glance (Ph. 284; Th. 537).—Modum, Norway. Hardness = 5·5; streak grey. Heated on charcoal, it decrepitates feebly; at first it disengages a weak smell of sulphurous acid, then fumes of arsenic, and requires an intense heat to fuse it into a dark globule, which is feebly attracted by the magnet; a very minute fragment of the fused assay, dissolved in borax on platina wire, communicates to it a deep purple colour.

Cobalt, Goose-dung (Ph. 306).—Allement, Dauphiné, France. Soft. On charcoal it becomes black; gives off slight arsenical fumes, and fuses slowly into a dark-coloured bead, very feebly magnetic; a fragment of the bead colours borax deep blue. Contains much water. Thompson, at page 535, mentions yellow and brown cobalt ochres. This is the "Gansekothig-erz," of the Germans.

Cobalt, massive grey (Ph. 286; Th. 533).—Bieber, Hesse. Hardness 5·5; streak shining; powder nearly black. On charcoal emits copious arsenical fumes, and leaves a small black globule, magnetic. A minute fragment colours borax deep blue.

Cobalt, massive tin white (Ph. 286; Th. 533).—Schladining, Styria. Hardness = 5·5; streak shining; powder grey. Emits copious arsenical fumes on charcoal, and fuses readily into a black globule, feebly magnetic. A minute fragment of the roasted globule colours borax deep blue.

Cobalt, Slickensides, sulphuret of.—Hardness = 5·0; powder black. On charcoal it decrepitates violently. Does not contain any water. Reduced to fine powder, and moistened, it may be fused rather readily, on charcoal, into a black globule, very feebly magnetic. Before fusing it emits fumes of sulphurous acid and weak arsenical fumes. A minute fragment of the bead colours borax deep blue.

Cobalt, tin-white (P. 286; Th. 533).—Bieber, Hesse. Hardness = 5·0; streak shining; powder grey. On charcoal speedily emits fumes of arsenic, and fuses readily into an iron-grey globule, not magnetic. A minute portion of the fused globule colours borax a deep blue.

Cobalt, tin white (Ph. 286; Th. 533).—Wittichen, Baden. Emits copious arsenical fumes, and fuses into a globule which is magnetic; in other respects same as last.

Coccolite (Th. 190; Al. 143).—Arendahl, Norway. Yields with some difficulty to the knife. In the forceps fuses on the edge, with effervescence, into a greenish translucent glass. No water. With borax it is very slowly soluble. A minute fragment forms a bead.

Colophonite (*Vide* **Garnet**). (Th. 147; Al. 200).—Arendahl, in Norway. Resists the knife. In the forceps fuses readily, with much intumescence and effervescence, into a shining dark-brown globule, not magnetic. No water. With borax breaks up, and fuses readily, with slight effervescence, into a glass, deeply coloured by iron. Contains some manganese.

Columbite (*Vide* **Tantalite**). (Ph. 272; Th. 484).—Resists the knife. Decrepitates in the flame of candle in a strong heat; glazes on the edge. Some moisture. With borax emits a few bubbles; breaks up into minute greenish fragments, and dissolves slowly into a glass, coloured by iron, which, if saturated, becomes greyish-opaque by flaming. No manganese or tungsten.

Copper, acicular muriate of (Ph. 325).—Bemolinos, Chili. Streak greenish-white. On charcoal it decrepitates; powdered and moistened, it colours the flame green and blue, and is reduced readily to metallic grains. Contains much water.

Copper, antimonial grey.—Crinnis Mine, Cornwall. Yields easily to the knife; brittle. On charcoal it decrepitates violently, but when reduced to a fine powder, and moistened, it fuses readily, with some ebullition and scintillation, into a dark scoriaceous bead, attracted feebly by the magnet. While fusing it emits sulphurous acid fumes, and deposits a white powder, which becomes orange when moistened with hydro-sulphuret of ammonia. It is scarcely reducible *per se* on charcoal, but with carbonate of soda it soon yields a malleable globule.

Copper, black oxide of (Th. 318; Ph. 598).—Knockmahon Mines, Waterford. Yields to the nail; soils. On charcoal emits some sulphurous fumes, and fuses readily, with some ebullition, into a dark grey globule, not magnetic, and when well roasted it yields a bead of copper. It contains some water.

Copper, blue carbonate of (Ph. 319; Th. 618).—Chessy, near Lyons, France. Yields easily to the knife; hardness about = 4; streak pale blue. It effervesces with muriatic acid, particularly when scraped. On charcoal it blackens, then fuses rather readily, with some ebullition, into a dark-grey bead, which consists of red oxide of copper, as is evident by powdering it; and, when well roasted, a globule of pure copper is obtained. It contains some water. It is not so readily reduced as the red oxide.

Copper, fibrous green carbonate of (Ph. 320; Th. 602).—Knockmahon Mines, Waterford. Yields easily to the knife; streak pale green. Effervesces with muriatic acid. On charcoal it blackens, and fuses quietly into a bead, which affords metallic copper much sooner than the blue carbonate. It contains a good deal of water.

Copper Glance (Ph. 308; Th. 599).—Botallack mine, Cornwall. Sectile. On charcoal fuses readily, with some ebullition and scintillation, into a dark grey bead, not attracted by the magnet. While fusing it emits slight smell of sulphurous acid; and when well roasted, a globule of metallic copper will be found on breaking the assay.

Copper, massive Vitreous Sulphuret of (*vide Copper Glance*), (Ph. 388; Th. 599).—Knockmahon Mines, Co. Waterford. Sectile; powder black. On charcoal fuses readily, with some ebullition and scintillation, into a dark grey globule, feebly attracted by the magnet. Gives off slight sulphurous smell; and when roasted, a globule of copper will be found on breaking the assay.

Copper, oblique prismatic arseniate of (Ph. 331).—Cornwall. Streak bluish-green. On charcoal it melts very speedily into a fluid mass; emits smell of arsenic, and gives a bead of copper when well roasted. It contains water.

Copper, octohedral arseniate of (Ph. 329).—Ting Tang, Cornwall. Yields easily to the knife; streak nearly white. On charcoal, at a low heat, it becomes green, then black, and fuses into a black scoria; disengages a slight smell of arsenic; and when well roasted, it yields grains of copper. Contains much water.

Copper ore, grey.—Gross Kogel, Tyrol. Brittle; yields easily to the knife; colour of cut surface bright lead grey. On charcoal it decrepitates violently, but when reduced to a fine powder and moistened, it fuses readily, with some ebullition and scintillation, into a dark scoriaceous bead, attracted feebly by the magnet. While fusing, it emits sulphurous acid fumes, and deposits a white powder, which becomes orange when moistened with hydro-sulphuret of ammonia. It is scarcely reducible *per se*, or charcoal, but with carbonate of soda it soon yields a malleable globule. In the open tube it decrepitates, emits acid fumes, and deposits a white powder, which becomes orange with hydro-sulphuret of ammonia.

Copper, phosphate of (Ph. 327).—Leibethen, Hungary. Yields easily to the knife; streak greenish. On charcoal it fuses readily, with ebullition, into a dark shining bead, which, when well roasted, emits a flash of light; when congealing, it then yields a bead of copper. Contains a little water.

Copper, plush-like Arseniate of (Ph. 332).—Cornwall. On charcoal it speedily fuses, with ebullition, into a fluid mass; emits copious fumes of arsenic, and is very soon reduced into a metallic bead. Contains a trace of water.

Copper, purple (*vide* **Buntkupfererz**). (Ph. 310; Th. 622).—Moldawa, Bannat. Brittle, sectile; colour of cut surface, pale copper-red. On charcoal it fuses readily, without ebullition, into a dark grey globule, attracted by the magnet. While fusing, it emits a sulphurous smell; and when well roasted, a globule of copper.

[**Copper pyrites.**—Roasted on charcoal, forms a globule readily, which, when dissolved in borax, adding nitre, proves the presence of abundant iron, by the green colour of the bead when warm; and of copper, by its intense blue when cold.—Ed.]

Copper, red oxide of (Ph. 316; Th. 598).—Cornwall, Hardness about = 4; streak red. On charcoal it fuses readily, and is speedily reduced. In the forceps it colours the flame green, and is reduced.

Copper, rhomboidal arseniate of (Ph. 330).—Cornwall. On charcoal it decrepitates, and is reduced to very minute scales; but if very slowly heated, it fuses into a dark scoria. Emits some arsenical odour; and when well roasted, it yields grains of copper. No water.

Copper, right prismatic arseniate of (Ph. 332).—Cornwall. Streak nearly white. On charcoal emits smell of arsenic; fuses readily into a fluid mass, and is very soon reduced into a metallic globule. No water.

Cork, mountain (*Vide* **Hornblende**). (Th. 208; Al. 147).—In a low heat it becomes orange-red, and fuses readily, with very slight effervescence, into a shining black bead. Contains some water. With borax fuses readily into a clear glass, coloured by iron. No manganese.

Corundum (*Vide* **Emery**) (Th. 211; Al. 167).—East Indies. Scratches steel readily. In the forceps it is quite infusible. Almost infusible with borax. Heated with solution of nitrate of cobalt, it becomes blue.

Corundum, crystallized.—Mozzo, in Piedmont. Scratches topaz. In the forceps it becomes white, and is infusible. With nitrate of cobalt it becomes blue. Contains a trace of water, and is almost infusible with borax.

Crucilite (Th. 435).—Clonmel, Co. Tipperary. It is soft. In the forceps fuses on the edge into a grey glaze, and becomes highly magnetic. It contains a good deal of water. The crucilite is decomposed arsenical iron.

Cryolite (Th. 251; Al. 22).—Ivakœet, Arksut Fiord, South Greenland. Yields easily to the knife; nearly as hard as calc spar. Does not fuse in the flame of a candle; on charcoal fuses readily into a very fluid colourless globule, which becomes white and opaque when cold; and if kept for a short time in the reducing flame, it is converted into a white infusible scoria. With nitrate of cobalt the scoria becomes blue. Contains no water. With borax it fuses

speedily into a colourless bead, which becomes opaque on cooling, if it be saturated; and at a certain point of saturation, if cooled slowly, small rectangular crystals may be observed. A little of the powder with sulphuric acid, heated on a piece of platina foil, corrodes a piece of glass placed over it.

Cyprine (*Vide* **Idocrase**) (Th. 262; Al. 198).—Souland, Tellemarken, Norway. Very brittle; yields to the knife; streak white. In the forceps it fuses readily, with intumescence and effervescence, into a muddy-green bead, red at its base, and colours the flame behind the assay a rich yellowish-green. No water. With borax it breaks up, and fuses speedily into a clear glass, coloured by iron while warm. A fragment fused with borax, and touched with nitrate of potash, indicates the presence of manganese. Berzelius and Thompson have omitted to notice the very characteristic colour given to the flame behind the assay. Although Berzelius has not mentioned it, he probably observed it, and was on that account induced to name it "Cuperiferous Idocrase." Dr. Thompson could not detect copper, and I also failed to detect it by reagents with the blowpipe.

Datholite (*Vide* **Botryolite; Borosilicate of Lime**).

Diallage (Th. 173.)—The Lizard, Cornwall. Hardness about = 3; streak white. In the forceps fuses on the edge slowly. Contains water With borax fuses slowly [with effervescence—Ed.] into a glass coloured by iron.

Diaspore (*Vide* **Alumina, hydrated**).—In the forceps decrepitates slightly; blackens at first, and in a strong heat becomes white like enamel, but is infusible. With acetate of cobalt becomes blue. Gives off some water in the matrass. With borax effervesces a little at first, becomes white, tinges it faintly with iron while warm, and fuses very slowly. Entirely, but very slowly, soluble with bisulphate of soda.

Dichroite (*Vide* **Iolite**). (Th. 277; Al. 177).—Eric Matts, Sweden. Resists the knife. In the forceps fuses on the edge into a greyish blebby glass. No water. With borax emits some bubbles, and fuses rather slowly into a colourless glass.

Dipyre (Th. 271; Al. 139).—Manleon, Pyrenees. Hardness about = 4·0. In the forceps it fuses with effervescence, and some intumescence, into a blebby greyish globule. Contains a little water. With borax fuses, with continued effervescence, into a glass slightly coloured by iron.

Dolomite.—From Mountrath, Queen's County. Scarcely as hard as calc spar. Effervesces briskly with nitric acid. In the forceps fuses on the edge into a greyish blebby translucent glass. No water. With borax effervesces briskly, and dissolves speedily. Contains a little iron. Heated with nitric acid, it leaves a large insoluble residue.

Edelite (*Vide* **Prehnite**) (Th. 317).—Tyrol. This mineral consists of two distinct substances—the dark red, or central portion, and the pale red fibrous portion.

The dark red central portion yields to the knife with difficulty; streak white. Hardness about = 5·5. Does not effervesce with muriatic acid. In the forceps it becomes white, and fuses, or rather only glazes, on the edges. With nitrate of cobalt it becomes blue. Contains much water. With borax it dissolves very slowly into a colourless glass.

The pale red fibrous portion yields very easily to the knife; streak white. Effervesces briskly with muriatic acid. Contains some water. In the forceps glazes on the edge, and becomes alkaline. With borax it effervesces much, and fuses very quickly into a transparent glass, feebly coloured by iron. It dissolves in large quantity, and cannot be made opaque by flaming.

Edenite.—North America. Yields to the knife. Hardness about = 5·5. In the forceps intumesces and effervesces much, and fuses rather readily into a very pale bluish globule, slightly blebby and transparent. No water. With borax fuses rather slowly into a transparent glass slightly tinged with iron.

Egeran (*Vide* **Idocrase**) (Th. 259).—Eger, near Haslau, Bohemia. Its characters correspond with Norway Idocrase, except that it does not contain manganese.

Elæolite (*Vide* **Nepheline**). (Th. 363; Al. 142).—Stavern, Norway. Hardness about = 6·0; streak white. In the forceps soon fuses on the edge into a blebby colourless glass, but forms a bead slowly. No water. With borax it dissolves very slowly; reduced to powder, and moistened with nitric acid, it gelatinizes speedily.

Emery (*Vide* **Corundum**). (Th. 211; Al. 167).—East Indies. Its characters are the same as Corundum.

Emery—Ochsenkopf, near Schneeberg in Saxony. Scratches quartz readily. Magnetic. In the forceps, in a good blast, it fuses into a black magnetic slag. With borax the iron dissolves, leaving a large residue.

Emmonite.—Massachussets. Hardness = 3·0. Effervesces with nitric acid, and otherwise corresponds with the characters of carbonate of strontian. Thompson's Records of Science, June, 1836, p. 414.

Epidote (*Vide* **Arendalite**; **Zoisite**). (Th. 364; Al. 150).—From Bourge D'Oisans, Dauphiné. Resists the knife. In the forceps intumesces, and fuses readily into a brown scoria, which, in a good heat, melts into a brilliant black bead; not magnetic. No water. With borax it breaks up, and fuses rather readily into a clear glass coloured by iron.

Epidote.—Knockmahon Cliffs, County Waterford. In the forceps it fuses, with intumescence and effervescence, readily into a dark scoria, which, in stronger heat, is converted into a shining black enamel. No water. With borax fuses into a glass coloured by iron while warm.

Epidote, manganesian (Th. 366; Al. 151).—From Aosta, Piedmont. Hardness about = 5·5. Scratched by a knife, streak reddish pink. In the forceps it intumesces much, effervesces, and fuses readily into a

brilliant dark purple bead. No water. With borax it effervesces, and dissolves speedily into a glass of a deep violet colour.

Epistilbite (Al. 127).—Faroe. Hardness about = 4·0. In the forceps it intumesces and curls up a little, and fuses readily into a white blebby globule, rendered perfectly transparent in a long-continued heat. Contains much water. With borax fuses readily into a colourless glass; gelatinizes slightly in cold nitric acid.

Erinite (Th. 341).—Antrim. Yields to the nail; streak white; feels soapy. In the forceps becomes white, and fuses with slight effervescence into a white blebby glass, rendered more transparent in a strong heat. Contains much water. With borax it effervesces a little at first, and fuses rather slowly into a colourless glass; with nitrate of cobalt it fuses into a blue glass; with bi-phosphate of soda it dissolves slowly into a colourless glass, which becomes opaline when cold, and leaves a transparent skeleton of silica. Mr. Allen had given the name of Erinite to an Arseniate of copper, said to be from the county Limerick, previous to the publication of Dr. Thompson's Mineralogy.—Allan, p. 83.

Essonite (*Vide* **Garnet**). (Th. 265; Al. 201).—County Donegal. About as hard as quartz. In the forceps fuses quietly and rather readily into a transparent greenish globule, slightly blebby. No water. With borax dissolves slowly into a glass coloured by iron.

Fahlunite, massive (Th. 284; Al. 101).—Eric Matts, Sweden. Yields easily to the knife; almost sectile; streak white. In the forceps becomes white, and fuses on the edge (intumesces and curls up a little) and surface into a white blebby glass. Contains some water. With borax fuses very slowly into a colourless glass.

Fluate of Lime, octohedral.—In the forceps decrepitates violently; reduced to powder, and moistened, it fuses readily into a white bead, which turns turmeric paper brown. Contains some water. With borax fuses rather readily into a clear glass, which becomes opaque by flaming, if a sufficient quantity of the assay be used; heated on platina foil with sulphuric acid, it corrodes glass placed over it. Some specimens, in the forceps, phosphoresce, and emit a ***purple*** light for an instant, decrepitating slightly.

Franklinite (Ph. 219).—New Jersey, North America. Yields to the knife. Powder reddish-brown. A minute fragment is taken up by the magnet. In the forceps it fuses on the edge with some difficulty, and is rendered more attractable by the magnet. No water. With borax it dissolves slowly, the glass is coloured by iron; by adding a little nitre, the purple colour of manganese becomes evident in the outer flame. I believe Franklinite contains much less of manganese than its analyses indicate.

[**Fuchsite.**—Tyrol. In the forceps, fusible on the edge with great difficulty. With borax dissolves very readily, with effervescence, leaving a permanent green colour in the bead (chrome). In microcosmic salt dissolves with equal facility, leaving a skeleton; and the bead is coloured green when hot, colourless when cold (iron).—Ed.]

Fuller's Earth (Th. 246; Al. 307).—Nutfield, Surrey. Adheres to the tongue. Yields to the nail, and receives a polish from it; immersed in water, it falls into a pulpy mass. In the forceps it becomes brown, intumesces slightly, effervesces, and fuses readily on the edges into a greenish enamel, and forms a greyish blebby bead with difficulty. Contains water. With borax dissolves rather slowly into a transparent glass coloured by iron while warm.

Gabronite (Th. 289).—Stavern, Norway. Translucent on the edge. Yields to the knife: hardness about = 5·5; streak white. In the forceps, when gently heated, it becomes white and opaque, and a thin fragment fuses into a white blebby globule, which becomes transparent, if intensely heated. Contains little water. With borax it effervesces a little at first, and fuses very slowly into a colourless glass.

[**Gadolinite**.—Sweden. In the forceps glows intensely, and turns whitish-grey, fusing on the edge with slight intumescence. Contains water. With borax dissolves readily, giving a transparent bead coloured with iron. With microcosmic salt dissolves very slowly, and gives a transparent bead.—Ed.]

[**Gadolinite**.—County Donegal. In the forceps fuses readily into a black bead, with intumescence and ebullition. Contains water. With borax dissolves readily, with effervescence at first, into a bead coloured by iron when hot, colourless when cold; with nitre added, behaves as before, but the bead is greyish when cold. In microcosmic salt, dissolves, leaving a siliceous skeleton; bead coloured by iron while hot, of pearl-grey colour when cold, and somewhat opaque when nitre is added.—Ed.]

Garnet.—Vesuvius. In the forceps it fuses, with slight effervescence, into a dark green glass. Contains no water. With borax it effervesces a little at first, and small fragments fuse very slowly into a colourless glass, indicating a little iron while warm.

Garnet (*Vide* **Allochroite, Colophonite, Cinnamon Stone, Essonite**).—Resists the knife; hardness nearly = 7·0. In the forceps it fuses readily into a very brilliant black magnetic globule; in the inner flame it intumesces a little. No water. With borax fuses slowly into a glass deeply coloured by iron.

Garnet.—Resists the knife; hardness about = 7·5. In the forceps in a low heat becomes opaque, but regains its transparency on cooling; fuses quietly into a brilliant black globule, not magnetic. With borax fuses slowly into a glass coloured by iron.

Garnet, Pyrope or **Bohemian** (Th. 268; Al. 200).—It is not affected by the file. In the forceps, in a low heat, it becomes opaque, and regains its colour and transparency when cold; in the inner flame it effervesces, and fuses on the surface into a dark green glass, and scarcely forms a bead. Contains no water. With borax it fuses very slowly into a clear glass, indicating iron while warm, but becomes a bright chrome green when cold. [Fuses on the edge with difficulty. With borax fuses with difficulty into a bead coloured permanently green, indicating the presence of chrome.—Ed.]

Garnet, yellow manganesian.—Franklin Furnace, Sussex, New Jersey. Resists the knife. In the forceps fuses readily into a shining black globule. No water. With borax dissolves slowly into a glass coloured by iron; when nitre is added, and again heated, the glass becomes deep purple.

Gehlenite (Th. 281; Al. 161).—From Mount Monzoni in the Valley of Fassa, in the Tyrol. Scarcely yields to the knife; streak white. In the forceps fuses rather slowly on the edge, with some ebullition, into a muddy green glass; a very small fragment fuses into a bead. Contains a little water. With borax fuses slowly into a colourless glass, indicating a little iron while warm; with biphosphate of soda fuses slowly into a clear glass, which becomes opaline when cold, and leaves a skeleton of silica undissolved. This specimen does not gelatinize when reduced to powder, and moistened with nitric acid. Thompson asserts it does.

Gibbsite (*Vide* **Alumina, hydrated**).

Giesockite (Th. 382; Al. 100).—Akulliarasiarksuk, Greenland. Yields readily to the knife; streak white. In the forceps whitens; and in a good blast fuses on the edge into a white enamel. With borax it effervesces a little at first, and fuses very slowly into a colourless glass, indicating iron while it is warm. Rare.

Gilbertite (Th. 235).—Cornwall. Yields easily to the knife; sectile. In the forceps fuses slowly on the edge into a white enamel. Trace of water. With borax emits a few bubbles, and fuses slowly into a colourless glass; with acetate of cobalt, a deep blue.

Gmelinite (*Vide* **Hydrolite**). (Th. 340; Al. 119).—Island Magee, county Antrim. Yields rather easily to the knife; hardness 4·5; streak white. In the forceps partly falls to powder, then fuses quietly but slowly into a white blebby glass, semi-transparent when intensely heated. Contains much water. With borax fuses readily, leaving a skeleton which dissolves slowly; does not gelatinize with nitric acid.

Grenatite (Th. 279; Al. 202).—Manetsok, North Greenland. Scarcely yields to the knife. In the forceps it is infusible, but in a thin fragment blackens, and glazes a little in a good blast. Not magnetic after roasting. With borax effervesces a little, and is scarcely soluble.

[**Grenatite.**—Fuses with extreme difficulty, on the edge, turning black; and with borax, dissolves very slowly, with slight effervescence at first.—Ed.]

Halloysite (Th. 239; Al. 73)—Angleur, near Liege, France. Adheres to the tongue. Yields to the nail, and receives a polish from it; brittle. In the forceps it becomes first brown, then white; and is almost infusible; a thin edge glazes in a good blast. Contains much water. With borax it is nearly insoluble. Heated with nitrate of cobalt, it becomes blue on the edge.

Harmotome.—Strontian, Argyleshire. Yields rather easily to the knife. In the forceps, when roasted, it becomes white and opaque, and very

brittle, and fuses quietly into an opaline globule. Contains much water. With borax it breaks up, and dissolves very slowly into a colourless glass.

Harmotome (Th. 349; Al. 116).—Luganure, county Wicklow. It requires a stronger heat to fuse it than the specimens from other localities; characters similar in other respects.

Harmotome (Th. 349; Al. 116).—North of Ireland. Hardness about = 4·0. In the forceps becomes white and opaque, and fuses quietly into a milky globule, slightly blebby, and not rendered more transparent in a strong heat. Contains much water. With borax dissolves very slowly into a colourless glass.

Harmotome (Th. 349; Al. 116).—St. Andreasberg, Hartz Mountains. Yields to the knife with some difficulty. In the forceps becomes white, and fuses rather slowly into a white bead, rather opaque, and not blebby. Contains much water. With borax dissolves very slowly into a clear glass.

[Many specimens of Harmotome, in the forceps, decrepitate and become opaque, afterwards glow brilliantly, and then fuse, indicating soda by the flame.—Ed.]

Haüyne.—Vesuvius. Does not yield to the knife. In the forceps, in a good blast, fuses on the edge, with very slight effervescence, into a colourless blebby glass. With borax effervesces and fuses in large quantity, into a colourless glass.

Helvine (Th. 522.)—Saxony. Hardness = 6·0; streak white. In the forceps fuses with effervescence into an opaque yellow globule. With borax indicates manganese in the oxidating flame. No water.

Hematite, fibrous brown (*Vide* **Iron, hydrous oxide of**). (Ph. 221).—Glandore, County Cork. Hardness = 5; streak bright yellowish-brown. In the forceps blackens and becomes magnetic, and fuses on the edge. Contains water.

Hematite, fibrous red (Ph. 218).—Restormal Mine, Lostwithiel, Cornwall. Not attracted by the magnet. Yields with some difficulty to the knife. Hardness 5·5; streak dark red. In forceps decrepitates at first, and fuses into a grey magnetic scoria. It contains some water.

Heulandite (Th. 346; Al. 126).—Osteröe, Faröe Isles. Hardness about = 3·5. In the forceps becomes white; intumesces much; curls up; fuses into a white blebby bead. Contains much water. With borax it fuses rapidly into a colourless glass. The white rough grains are infusible alone, and very slowly soluble with borax. Reduced to a fine powder, it does not gelatinize when moistened with nitric acid.

Hisingerite.—Bodenmais, Bavaria. Yields to the knife; streak brownish. In the forceps it fuses on the edge, and becomes magnetic. Contains much water. With borax fuses speedily into a glass coloured by iron. No trace of manganese.

Hornblende, (*Vide* **Amphibole; Anthophyllite; Asbestus; Cork, mountain; Smaragdite**).—Norway. Yields to the knife. In the

forceps fuses readily, and with scarcely any effervescence, into a black globule [or black scoriaceous mass—Ed.] No water. With borax emits a few bubbles, and dissolves slowly.

Hornblende, ferruginous (Th. 198; Al. 145).—Hardness = 4·5; streak greenish. In the forceps intumesces and effervesces a good deal, and fuses very speedily into a black globule, feebly magnetic. No water. With borax dissolves speedily into a glass deeply coloured by iron. No manganese.

Hydrolite (*Vide* **Gmelinite**). (Th. 340; Al. 119).—North of Ireland. Hardness about = 4·0. In the forceps becomes white, and falls to powder; if very slowly heated, it fuses into a blebby white globule. Contains much water. With borax effervesces a little at first, and fuses readily into a colourless glass, leaving a small residue, which is more slowly soluble.

Hypersthene (*Vide* **Pyroxene**). (Th. 201; Al. 106).—Hardness about = 4·5. Superficial streak brown, deep streak greenish-grey. In the forceps a small portion fuses into a dark green bead; a large piece fuses only on the edge. Contains a trace of water. With borax fuses rather readily into a clear glass, coloured by iron. No manganese. It is rarely found crystallized.

Hypersthene.—Hardness about = 5·0; streak white. In the forceps in the inner flame fuses on the edge, with some ebullition, into a dark glaze. No water. With borax fuses very slowly into a glass coloured by iron.

Idocrase (*Vide* **Egeran**; **Cyprine**). (Th. 259; Al. 198).—Yields to the knife; streak white. Hardness about = 5·5. In the forceps it fuses readily, with intumescence and effervescence, into a brilliant dark-coloured globule, which in the outer flame becomes nearly transparent; and its opacity is restored in the reducing flame. With borax it effervesces a little, and fuses speedily into a glass coloured by iron.

Idocrase.—Norway. Resists the knife. In the forceps intumesces and effervesces much, and fuses readily into a dark, olive-coloured brilliant globule; not rendered more transparent by flaming. No water. With borax it breaks up, and fuses speedily into a clear glass, coloured by iron, which gives a trace of manganese on the addition of nitrate of potash.

Iolite (*Vide* **Dichroite**; **Pyrargillite**).

Iron, Arseniate of.—Cornwall. Yields very readily to the knife; streak nearly white. On charcoal it fuses readily, with intumescence, into a dark globule, attracted by the magnet; it emits some smell of arsenic. Contains water. Dissolves readily with borax.

Iron, carbonate of. (*Vide* **Sphærosiderite**).—Cornwall. Yields easily to the knife; streak white. Does not effervesce with cold acids. In the forceps, by a gentle heat, it assumes a shining black colour, and becomes magnetic; in the inner flame it fuses on the edge. No water. With borax it emits bubbles at first, and dissolves readily into a glass deeply coloured by iron.

Iron, crystallized Oligist (Th. 434.)—Isle of Elba. Yields with some difficulty to the knife. Hardness = 5·5; streak red. Feebly attracted by the magnet. In the forceps fuses with difficulty on the edge, [throwing out brilliant scintillations, if the experimenter understand the use of his blowpipe—Ed.] and becomes strongly magnetic. With borax it dissolves slowly into an olive-yellow glass.

Iron Earth, blue, (subsesquiphosphate of Iron).—Cornwall. Yields to the nail; streak blue. It fuses readily into a metallic-looking globule; magnetic when well roasted. Contains much water. With borax it fuses speedily into a glass coloured by iron.

Iron, hydrous oxide of (*Vide* **Hematite, brown**). (Th. 320).—Restormal Mine, near Lostwithiel, Cornwall. Not magnetic. Brittle; hardness = 5·0; streak yellowish-brown. In the forceps fuses on the edge without difficulty, and in a strong heat scintillates; it becomes strongly magnetic. Contains water.

Iron, magnetic oxide, fasciculated columnar.—Bohemia, or Franconia. Before roasting, and in a good heat, fuses into a black magnetic scoria.. Contains water. It is very remarkable for its magnetic property.

Iron, massive phosphate of.—North America. Streak bluish. In the forceps it decrepitates; but if slowly heated, it fuses readily into a black globule. This appears to be the Mullicite of Thomson, p. 452.

Iron Ore, bog (Ph. 222).—North of Ireland. Hardness about = 3·5. Powder yellowish-brown. In the forceps blackens, fuses readily on the edge, and becomes magnetic. Contains much water.

Iron ore, Lamellar Specular.—Arinahincha, county Cork. Not magnetic. Yields to the knife. Powder dark red; very thin laminæ transmit a blue-red light, when viewed with a lens. In the forceps it fuses on the edge, and becomes magnetic.

Iron, oxydulated, (Magnetic Oxide).—Haytor Mine, Dartmoor, Devonshire. Brittle; hardness = 5·5; powder black. Attracted by the magnet, but does not attract iron filings. In the forceps, in a strong heat, it fuses on the edge, into a steel-grey mass, but a small fragment forms a bead with great difficulty. With borax fuses rather readily into a glass deeply coloured by iron.

Iron, phosphate of (Vivianite), (Th. 455).—Dobschau, Hungary. Yields very easily to the knife; hardness = 1·5; streak blue. In the forceps it fuses very readily into a greenish-black globule, with a metallic lustre, which becomes magnetic when well roasted. Contains much water. With borax it fuses speedily into a glass coloured by iron. It contains no manganese.

Iron Pyrites, magnetic (Ph. 213).—Hardness about = 4·5. Powder greyish-black. On charcoal it emits the smell of sulphurous acid, and fuses readily into a globule, brilliant while hot, greyish-black and rough when cold. It is attracted by the magnet, both before and after roasting.

Iron, radiated carbonate of.—Kannioak, Greenland. Hardness = 4; streak white. Does not effervesce with cold muriatic acid; dissolves with effervescence in warm acid. In the forceps it blackens, and be-

comes magnetic; in a strong heat it fuses on the edge into a black glaze. Contains water. With borax effervesces, and dissolves readily into a glass coloured by iron. No trace of manganese. This mineral is generally supposed to be brown wavellite, and is sold in London at a very high price.

Iron, Titaniferous (Ph. 216).—Auvergne. Translucent on the edge. Hardness=5·0–5·5; streak greyish. Infusible. With borax slowly soluble into a glass coloured by iron; with salt of phosphorus, dissolves slowly into a glass coloured by iron while warm; reddish amethyst colour when cold.

Iron, Tungstate of (Wolfram), (Ph. 236).—Zinwald, Bohemia. Hardness = 4·5; streak reddish-brown. In the forceps it fuses rather readily into a black scoriaceous bead not attracted by the magnet. No water. With borax, dissolves readily, in the outer flame, into a glass, reddish-purple when cold; in the inner flame it is greenish while warm, and nearly colourless when cold.

Isopyre (Th. 377; Al. 190).—From Huel Bassett, Cornwall. Not so hard as quartz; powder greenish-white; thin fragments are translucent, with an olive colour. In the forceps it is infusible, but loses its colour and becomes greyish-white. Contains a good deal of water. With borax dissolves very slowly into a glass, coloured by iron while warm; with biphosphate of soda partially fuses, and becomes slightly opaline when cold, if saturated.

[**Jelletite.**—Saas Thal, Switzerland. Hardness = 7; sp. gr. = 3·741. In the forceps turns black, and fuses, with difficulty, on the edge. No water. With borax, fuses into a bead coloured with much iron. With microcosmic salt dissolves slowly, leaving no skeleton. This is a variety of Garnet.—Ed.]

Johannite (sulphate of Uranium) (Ph. 271).—Joachimstahl, Bohemia. Sectile; powder very pale green. In the forceps, at a low heat, it becomes orange-coloured; is reduced in size (probably owing to the vaporization of the water), and is infusible. Contains much water. With borax it effervesces, and dissolves readily into a glass of a yellow colour, not discharged on adding nitre. Dissolves readily in nitric acid, with effervescence; at least, the yellow pulverulent coating behaves thus with nitric acid. Extremely rare.

Karpholite (Th. 325; Al. 161).—Schlackenwald, Bohemia. Hardness about = 5·0; streak white. In the forceps becomes white, and fuses rather readily, with ebullition, into a yellowish bead. Trace of moisture. With borax, in outer flame fuses rather readily, with slight effervescence at first, into an amethyst-coloured glass.

Karpholite (Th. 325; Al. 161).—Schlackenwald, Bohemia. Hardness about = 4; streak white. In the forceps the fibres diverge, and fume with slight intumescence and effervescence into a pale brown scoria, which, in a good heat, forms a bead of the same colour. No water. With borax dissolves readily into a glass, coloured by manganese in the outer flame; in the inner flame it becomes colourless.

Killinite (Th. 330; Al. 102).—Killiney Quarry, near Dublin. Yields easily to the knife; streak white. In the forceps, at a low heat, it blackens, then intumesces a little, and fuses on the surface into a rough white enamel; a minute splinter fuses into a shining white globule. Contains some water. With borax effervesces at first, indicates some iron, and fuses very slowly into a colourless glass.

[In the forceps intumesces, and melts into a glassy bead, more readily than Spodumene; flame indicates slight trace of Lithia; and, in melting, the assay glows brilliantly.—Ed.]

Kirwanite (Th. 378).—Mourne Mountains, county of Down. Yields easily to the knife; streak nearly white. Effervesces with muriatic acid, very briskly if reduced to powder. In the forceps it intumesces, and effervesces a little at first, and fuses readily into a shining black globule, very feebly magnetic. Contains a little water. With borax it effervesces a little at first, and fuses rather quickly into a glass deeply coloured by iron. No trace of manganese.

Kyanite (*Vide* **Bucholzite**; **Rhætizite**).

Kyanite (Th. 241; Al. 108).—St. Gothard. Yields easily to the knife on the broad plane of the prism, while the edge of the crystal resists the file; streak white. In the forceps it is infusible; and when intensely heated, it loses its colour, and becomes white. Contains no water. With borax it is almost infusible. With nitrate of cobalt it becomes blue.

Kyanite (Th. 241; Al. 108).—Shetland Isles. Hardness about = 4·0. In the forceps infusible. No water. With borax scarcely soluble.

Labradorite (Th. 297; Al. 139).—Gweebarra River, Donegal. In the forceps fuses on the edge into a clear glass; in a good heat a small fragment forms a bead. With borax it is very slowly soluble. No water.

Laumonite (Th. 332; Al. 120).—Maggia, St. Gothard. Hardness about = 4·0. In the forceps, at a low heat, it blackens for an instant, then fuses quietly but slowly into a rough blebby colourless glass, and scarcely forms a bead. Contains a good deal of water. With borax it is very slowly soluble. Does not gelatinize in nitric acid.

Lazulite (*Vide* **Bluespar**).—(Th. 310; Al. 157).—Vorau, Styria. Yields to the knife; streak pale blue. In the forceps loses its colour, and fuses on the edge into a white enamel. With borax fuses into a glass coloured by iron.

Lead, arseniate of (Ph. 364).—Johanngeorgenstadt, Saxony. Hardness = 3·5; streak white. On charcoal it decrepitates a little; fuses readily; emits the smell of arsenic, and nothing remains but globules of metallic lead.

Lead, arsenio-phosphate of (Ph. 362).—Cumberland. Hardness = 3·5; streak white. On charcoal it fuses quietly, with some ebullition, into a globule, which on cooling becomes white, and crystallizes into polygonal facets, emits a faint smell of arsenic, and yields some globules of lead.

Lead, arsenio-phosphate of.—West Fell, Cumberland. Of a wax-yellow colour. Hardness = 3·0; streak yellow. On charcoal decrepitates; but if slowly heated, it melts, and emits a faint smell of arsenic; metallic globules of lead are formed, and enveloped in a glassy residue, which forms a globule with difficulty; it crystallizes on cooling. Rare. The dark-coloured crystalline globule, when fused with borax, forms a colourless glass, which becomes green when cold: this is, probably, owing to a minute portion of chrome.

Lead, fasciculated brown arseniate of.—Cornwall. Hardness = 3·5; streak white. On charcoal it fuses readily, and emits faint odour of arsenic, and nothing remains on the charcoal but grains of lead.

Lead, chromate of (Ph. 368; Th. 560).—Beresoff Mine, Siberia. Hardness = 2·5; streak and powder orange-yellow. On charcoal it decrepitates violently; reduced to powder, and moistened, it becomes black, and fuses readily into a black fluid mass; deposits minute globules of lead round the assay, and leaves a black scoria, infusible, and not magnetic. With borax fuses into a deep green glass, opaque unless a very minute portion of the assay be used.

Lead, molybdate of, crystallized (Th. 562).—Bleyberg, Carinthia. Hardness = 3·0; streak white. Decrepitates violently on charcoal; it fuses, when reduced to powder and moistened, into a yellow mass, and globules of lead are formed. With salt of phosphorus a small portion of assay fuses readily into a glass of a fine green colour.

Lead, muriate of (Ph. 360; Th. 557).—Churchill, in the Mendip Hills, Somersetshire. Hardness = 2·5; streak white. On charcoal it decrepitates; reduced to powder and moistened, it is speedily reduced to metallic lead on charcoal, and exhales white fumes; heated with biphosphate of soda, and peroxide of copper, the flame assumes a fine blue colour for an instant. Extremely rare.

Lead, phosphate of (Ph. 362).—Luganure, county Wicklow. Hardness = 3·5; streak white. On charcoal fuses readily, with slight ebullition, into a globule, yellow while warm, pearly white and crystallized when cold; with carbonate of soda it yields globules of lead.

Lead, phosphate of.—From Drigeth, West Fell, Cumberland. Soluble in warm nitric acid, without effervescence. Character same as last.

Lead, green phosphate of.—Luganure, county Wicklow. On charcoal it decrepitates; but if slowly heated, it fuses with some ebullition into a globule, which crystallizes in large facets when cold; but if the fusion is prolonged, it retains its globular form even when cold.

Lead, brown phosphate of.—Przibram, Bohemia. Hardness = 3·5; streak white. On charcoal fuses readily and quietly into a globule, which crystallizes in broad facets when cold; at the moment it crystallizes, a gleam of light is emitted by the globule; it does not contain arsenic; with carbonate of soda it gives globules of lead.

Lead, brown phosphate of.—Huelgoet, Lower Brittany. Hardness = 3·0; streak white. On charcoal minute particles fly off with slight decrepitation; fuses readily into a bead, which is white and crystal-

lized on its surface when cold. No water. With borax effervesces a little, and dissolves rapidly into a glass, transparent and yellow while warm, colourless when cold. Becomes opaque by flaming. With carbonate of soda it is speedily reduced.

Lead, sulphato-carbonate of (Ph. 358; Th. 567).—Lead Hills, Cumberland. Hardness = 2·5. Does not effervesce in acid; it is partly dissolved. On charcoal does not decrepitate, and fuses readily into a brown mass, and yields globules of lead.

Lead, sulphate of (Ph. 365; Th. 559).—Paris Mine, Isle of Anglesea. Hardness = 3·0. On charcoal, in the outer flame, fuses quietly and readily into a globule, which is white when cold, and in the reducing flame it speedily yields globules of lead.

Lead, sulphate of.—Luganure Mine, county Wicklow. It decrepitates strongly when heated; in other respects it is similar to the last. Extremely rare in this locality.

Lead, sulphuret of.—Hero Shaft, Luganure, county Wicklow. Yields easily to the knife. On charcoal it fuses quietly, and becomes very fluid; in the reducing flame it yields grains of lead, and deposits a yellow powder on the charcoal; does not emit smell of sulphur while fusing.

Lead, Tungstate of (Ph. 370).—Zinnwald, Bohemia. Hardness = 3·0; streak white. On charcoal it fuses readily into a dark-coloured globule. No water. With borax dissolves readily into a glass, which becomes opaque and white when cold, if a large portion of the assay be used.

Lead, vanadiate of (Ph. 370; Th. 573).—Wanlock Head, Lead Hills, Cumberland. The crystals are aggregated in small globules. Hardness = 3·0; streak white. On charcoal it fuses readily, with ebullition, and is partly reduced to metallic globules, and a black scoriaceous mass remains. No water. With borax it dissolves readily, and on cooling becomes opaque; and blue (by reflected light only), if the proportion of the assay be large; but if a small portion be used, the bead is emerald green.

Lead, vanadiate of, compact mamillated.—Wanlock Head, Lead Hills, Cumberland. Hardness = 3·5–4·0. Its pyrognostic characters are the same as the last.

Lehuntite (Th. 338).—Glenarm, county Antrim. Yields to the knife; hardness about = 4·0. In the forceps fuses quietly into a blebby colourless bead. Contains water. With borax it fuses rather slowly into a colourless glass. Gelatinizes feebly in nitric acid.

Lepidokrokite.—Pfortzheim, Baden. Yields easily to the knife; streak yellowish-brown. In the forceps fuses into a grey metallic-looking magnetic globule. With borax it fuses speedily into a glass deeply coloured by iron. Contains water. Nitre does not indicate manganese.

Lepidolite (Th. 361; Al. 93).—Rozena, Moravia. Yields easily to the knife; streak white. In the forceps fuses very readily, with intumescence and effervescence, into a white vesicular globule, which becomes transparent and colourless, if heated intensely for a short

time. With borax, it fuses speedily with effervescence, and in large quantity, into a colourless glass. [The borax bead, held in the oxydating flame, acquires an amethystine colour, indicating the presence of manganese—Ed.] I could not detect boracic acid by the blowpipe with Dr. Turner's flux of bisulphate of potash, and fluate of lime. While fusing, it tinges the flame behind the assay carmine-red, particularly if the jet be passed near the assay and does not envelope it; if the assay be fused with powdered fluor spar, the red colour is readily perceived. Heated with sulphuric acid on platina foil, and a piece of glass placed over it, it gives a trace of fluoric acid.

Leucite (Th. 286; Al. 112).—Yields to the knife. In the forceps emits a brilliant light, and in good blast fuses on the edge into a clear glass. With borax dissolves very slowly into a clear glass.

Levyne (Th. 335; Al. 118).—Benevenagh, county Derry. Yields to the knife. In the forceps becomes white, intumesces much, and fuses into a white blebby globule. Contains much water. With borax dissolves speedily into a transparent glass, with slight effervescence. Does not gelatinize with nitric acid.

Lievrite (Th. 148; Al. 230).—Rio la Marina, Island of Elba. Hardness about = 5·5; powder blackish-green. Not magnetic before roasting. In the forceps it becomes magnetic when gently heated, and fuses readily, with slight effervescence, into a black magnetic bead. With borax effervesces for an instant and fuses rather slowly into a transparent glass deeply coloured by iron. Does not contain manganese.

Lime, bissesquihydrous arseniate of, (Pharmacolite) (Th. 135; Al. 21).—Princess Sophia Mine, near Wittichen, Baden. On charcoal it gives out a faint arsenical odour. In the forceps it fuses readily, with some effervescence and intumescence, into a bluish globule, opaque. Contains much water. With borax fuses readily into a pale cobalt-blue glass.

Lime, phosphate of (*Vide* **Apatite**).—Arendahl. Hardness about = 4·5; streak white. In the forceps fuses slowly on the edge into a white glaze. No water. With borax it dissolves very slowly, and becomes opaque by flaming; it is entirely soluble in biphosphate of soda.

Lime, Tungstate of (Ph. 182).—Bohemia. Hardness = 4·0; streak white. In the forceps it becomes white, then grey, and fuses on the edge, with difficulty, into a dark grey glaze. No water. With borax dissolves, rather readily in the inner flame, into a glass bluish-grey when cold, and it becomes white by flaming.

Lime, Tungstate of, amorphous.—Schoenfield, Bohemia. Hardness = 4·0. Decrepitates a little; acts with fluxes like the preceding, except that it does not become grey in the reducing flame.

Lithomarge (Th. 374).—Adheres to the tongue. Yields to the nail, and receives a polish from it. In the forceps whitens, and is infusible. Contains much water. Nearly infusible with borax. With cobalt becomes blue.

Magnesia, carbonate of (Th. 157; Al. 39).—Down Hill, Derry. Hardness nearly = 5·0. With muriatic acid it effervesces briskly. In the forceps is infusible. No water. With borax it effervesces much, and dissolves readily and in large quantity into a glass, which becomes opaque by flaming, if it be saturated.

Magnesia, carbonate of (Th. 157; Al. 39).—Hoboken, New Jersey. Hardness = 4·5. Does not effervesce, unless reduced to powder. Infusible. No water. With borax effervesces briskly, and dissolves rapidly.

Magnesia, hydrate of (Th. 156; Al. 95).—Swinaness-Unst, one of the Shetland Isles. Soft, yields to the nail. Is entirely soluble in nitric acid, without effervescence. In the forceps it becomes white and opaque, but retains its pearly lustre, and is infusible. When roasted, it tinges turmeric paper brown. With acetate of cobalt becomes pale pink. Contains water. With borax fuses readily into a clear glass, which, if saturated, is opaque when cold.

Magnesia, hydro-carbonate of (Th. 159).—Hoboken, New Jersey. Structure fibrous, radiated, soft. Effervesces briskly with muriatic acid. In the forceps the fibres diverge and curl up much, but it is infusible. Contains a good deal of water. With borax dissolves readily, with slight effervescence.

Manganese, bisilicate of (Th. 516).—Ural Mountains, Siberia. Hardness = 5·7; streak white. In the forceps it fuses readily, with slight effervescence, on the edge, into a brown glass, and forms a bead with difficulty. No water. With borax it emits some bubbles, and fuses slowly into a glass of an amethyst colour in the oxydating flame.

Manganese, black oxide of.—Harz. Hardness = 4·0; powder black. Contains a good deal of water. Decrepitates a little when heated, and is infusible.

Manganese, lenticular carbonate of.—Schneeberg, Saxony. Hardness = 3·5. When scraped, it effervesces briskly with acid. In the forceps it decrepitates violently; reduced to powder, and moistened, it blackens, and is infusible. No water. With borax it effervesces briskly, and dissolves readily into a glass of a deep reddish colour.

Manganese, hydrated oxide of.—Glandore, county Cork. Hardness = 5·5–6·0. Powder brownish-black. In the forceps glazes on the edge, and is feebly attracted by the magnet. Contains a large portion of water.

Manganese, mamillated oxide of.—Restormal Mine, Lostwithiel, Cornwall. Hardness = 4·0. Powder black. Infusible. Contains some water.

Manganese, phosphate of, and Iron (Th. 472).—Near Limoges, France. Hardness = 5·0; streak greyish-white. In the forceps it decrepitates; but if gradually heated, it fuses readily, with slight intumescence, into a black bead, attracted by the magnet. A trace of water. With borax it dissolves readily. In the outer flame it indicates manganese, and in the reducing flame iron.

Manganese, sesquisilicate of (Th. 514). Franklin, New Jersey, North America. Colour nearly black. Hardness = 5·5; streak dark red. In

the forceps glazes on the edge, but does not fuse; it is attracted by the magnet after roasting. No water. Dissolves in borax; and it is difficult to exhibit the colour of the manganese in the outer flame.

Manganese, slaty oxide of.—Roury, county Cork. Hardness = 4·0. Powder black. Fuses on the edge into a black glass. Contains some water.

Manganese, sulphuret of.—Nagyag, Transylvania. Colour dark brown. Hardress = 4·0; streak greenish. Effervesces with muriatic acid, and gives out a smell of sulphuretted hydrogen. On charcoal it fuses quietly, but slowly, into a black scoriaceous bead, not attracted by the magnet. No water. With borax it is very slowly soluble, and the amethyst colour does not appear until the assay is entirely dissolved.

The grey portion.—Hardness = 2·5; streak grey. In the forceps it becomes black, and glazes on the edge, but does not fuse. Effervesces with muriatic acid, and emits a smell of sulphuretted hydrogen. With borax it dissolves very slowly, and the moment the assay is entirely dissolved, the amethyst colour is developed.

There appear to be two distinct combinations of sulphur and manganese in this specimen. Compare the analyses of Vauquelin, and Arfvedson in Allan's Manual of Mineralogy, page 279.

Manganite, crystallized (Th. 502).—From Lahn, on the Rhine. Hardness = 3·5. Powder greyish-black; infusible. Contains a little water. With borax gives an amethyst coloured glass.

Manganite, prismatic.—Hardness = 4·0; powder brown. Decrepitates; infusible. Contains some water.

Marmatite (sulphuret of Zinc and Iron) (Th. 548). Hardness = 4·5; streak pale yellowish-brown. In the forceps it does not decrepitate; it is more fusible than the common brown blende; it scarcely forms a bead, which is feebly attracted by the magnet. No water. With borax dissolves slowly into a glass, transparent while hot; muddy, opaque, and dark-coloured when cold.

Meionite (Th. 271; Al. 139).—Monte Somma, Vesuvius. Effervesces with muriatic acid. In the forceps intumesces and effervesces to a great degree, and fuses slowly into a blebby colourless glass. With borax fuses rather slowly, with *continued* effervescence. This specimen does not gelatinize with nitric acid. The effervescence is caused by a superficial coating of carbonate of lime on the crystals. The transparent part of the crystals does not effervesce. Yields with difficulty to the knife.

Mellilite (Th. 207; All. 207).—Capo de Bove, near Rome. Yields to the knife; hardness about = 4·5; streak white. In the forceps fuses readily into a transparent green glass bead. No water. With borax it dissolves slowly into a glass coloured by iron.

Menilite.—Menilmontant, near Paris. Hardness about = 7·0. In the forceps infusible, but becomes white and opaque. Contains water. With borax fuses slowly into a colourless glass.

Mesole.—Yields easily to the knife; scratched by fluor spar. In the forceps fuses readily, with some intumescence and effervescence, into a bead, transparent while hot, but white and opaque when cold. Contains much water. With borax effervesces a little at first, and fuses slowly into a glass, colourless and transparent; with nitrate of cobalt, it fuses into a blue glass. Reduced to powder, and moistened with nitric acid, it gelatinizes slightly. It is very tough.

Mesole (Al. 128).—Faroe Isles. Hardness about = 3·5. Its pyrognostic characters correspond exactly with those of Mesolite.

Mesole (Al. 128.)—Portrush, North of Ireland. Hardness about = 4·0. In the forceps becomes white; exfoliates a little; intumesces and fuses rather slowly into a white blebby bead. Contains much water. With borax it dissolves readily. When reduced to powder, and moistened with nitric acid, it gelatinizes.

Mesolite (Th. 317; Al. 122).—Yields with some difficulty to the knife. In the forceps it becomes opaque, exfoliates, intumesces, and fuses into a white blebby globule, which becomes more transparent in a stronger heat. Contains much water. With borax it effervesces a little at first, and then fuses readily into a transparent colourless glass, leaving a skeleton which is more slowly soluble. When powdered, it gelatinizes with nitric acid. This is the Skolezite of Mr. Allan.

[**Mica, Margarodite.**—Three-rock Mountain, county Dublin. Fusible on the edge with great difficulty. Contains water. · With borax dissolves readily. Leaves a' skeleton of silica in microcosmic salt, in which, however, it easily dissolves.—Ed.]

Molybdena, sulphuret of (Th. 88).—Cumberland. Yields to the nail. In the forceps it is infusible, and does not undergo any change with borax.

Mussite (*Vide* **Pyroxene**). (Th. 187; Al. 144).—Mussa, Piedmont. Hardness = 5·0. In the forceps, in the outer flame, fuses quietly into a clear glass; in the inner flame intumesces and effervesces. A piece the size of a pin's head fuses only on the edge. With borax fuses very slowly. Contains no water.

Nacrite (Th. 244).—Fair Mountain, Glendalough, county Wicklow. Yields easily to the knife; streak white. In the forceps fuses on the edge with difficulty, into a white enamel. Gives a trace of water. With borax it effervesces at first, and fuses slowly into a transparent glass, coloured by iron while warm. With biphosphate of soda partly fuses into a glass, which is slightly opaline when cold, if saturated, and leaves a large residue of silex.

Napoleonite (Th. 291). Corsica. Yields with difficulty to the knife; powder white. In the forceps becomes white, and fuses on the edge into a blebby glass. Does not contain water. Almost insoluble with borax.

Natrolite (Th. 315; Al. 121)—North of Ireland. Yields to the knife; hardness about = 5. In the forceps, at a low heat, it becomes opaque,

and fuses readily and quietly into a clear colourless globule; in a stronger heat it blisters on the surface. Contains water. With borax it fuses rather readily into a colourless glass. Reduced to powder, and moistened with nitric acid, it gelatinizes.

Natrolite, crystallized (Th. 315; Al. 121).—Hohentwiel, Suabia. Yields to the knife; hardness about = 5·0. The crystals fuse readily into a transparent colourless globule. The brown fibrous portion, when gently heated in the forceps, becomes red, and fuses readily into a blebby colourless bead, which becomes transparent in a good blast. Contains water. With borax fuses slowly into a colourless glass. Gelatinizes with nitric acid.

Needle Ore of Bismuth (Ph. 278; Th. 596).—Beresoff, Siberia. Yields readily to the knife; powder lead-grey. On charcoal fuses readily; emits some sulphurous fumes; is partly volatilized; deposits minute globules of lead around the assay; and after intense roasting a globule of pure copper remains. Extremely rare.

Nemalite (Th. 166; Al. 314).—From Hoboken, New Jersey. Does not effervesce in nitric acid, and is not entirely soluble in it. Infusible, but becomes pale brown. Contains water. Dissolves readily in borax into a glass slightly coloured by iron.

Nepheline, primitive (*Vide* **Elæolite**). (Th. 256; Al. 132). Vesuvius. Fuses into a colourless and transparent bead slowly in the forceps. Very slowly soluble in borax.

Nickel, copper-coloured.—Hardness = 5·5; brittle. On charcoal it soon gives arsenical fumes, and fuses rather slowly into a black bead, which is not magnetic. With borax the globule dissolves readily, and forms a blue glass. It alloys with the platina.

Nickel Ochre (Th. 528, and 524).—Cornwall. When heated on charcoal, becomes yellow; and, after long continued roasting, it fuses into a black scoria, which soon forms a globule, highly magnetic.

Nickel, sulphuret of (Th. 524).—Merthyr Tydvil, South Wales. On charcoal it fuses readily into a black globule, strongly attracted by the magnet. The fused globule dissolves readily in borax, and gives an amethyst-coloured glass; in a stronger heat the glass is violet-blue by transmitted light, and olive-green by reflected light.

Nuttalite (*Vide* **Scapolite**). (Th. 382; Al. 142).—Boston, Massachussets, North America. Yields to the knife with difficulty; streak white. In the forceps intumesces and effervesces much, and fuses slowly into a blebby colourless glass. Trace of moisture. With borax fuses rather quickly, with prolonged effervescence, into a transparent glass, faintly coloured by iron.

Obsidian (Th. 393; Al. 188).—Tokay, Hungary. Translucent on the edge. Resists the knife; hardness about = 6·5; powder greyish-white. In the forceps it becomes colourless, and fuses with difficulty on the edge into a slightly blebby, transparent, and colourless glass. Contains no water. With borax dissolves very slowly into a transparent colourless glass.

Olivine (Th. 163; Al. 192).—Otaheite. Resists the knife. In the forceps infusible. No water. With borax soon indicates iron, but fuses very slowly.

[**Olivine**.—Vesuvius. In the forceps fuses readily, with effervescence, into a black scoria. No water. With borax dissolves easily into a transparent bead, coloured by much iron. With microcosmic salt, dissolves readily, with continued effervescence, leaving a siliceous skeleton.—Ed.]

Orpiment (*Vide* **Arsenic, yellow sulphuret of**).

Paranthine (*Vide* **Scapolite**). (Th. 271; Al. 139).—Hardness = 4·5–5·0. In the forceps effervesces and intumesces, and fuses readily into a colourless blebby globule. No water. With borax dissolves readily, with prolonged effervescence, into a clear glass, slightly coloured by iron while warm.

Pearl spar.—Killiney Quarry, Dublin. Scratches calc spar. Effervesces feebly with nitric acid. In the forceps decrepitates slightly, becomes black, and fuses on the edge into a black glaze, not magnetic. No water. With borax effervesces much, and dissolves readily. Contains iron.

Pearl Spar.—Knockmahon, county Waterford. Scratches calc spar. Effervesces with muriatic acid when scraped. In the forceps decrepitates violently; infusible; effervesces strongly with borax.

Pearlstone (Th. 390; Al. 188).—Bochnitz, Hungary. Hardness = 5·0; brittle. In the forceps intumesces much, suddenly, and fuses very slowly into a rough, blebby, colourless glass. No water, or only a trace. With borax emits a few bubbles, and fuses rather readily into a clear glass.

Phillipsite (Th. 351: Al. 117).—Island Magee, North of Ireland. In the forceps becomes white and opaque, falls partly to pieces, and fuses rather slowly into a transparent rough bead. Contains much water. With borax it becomes transparent, and fuses slowly into a colourless glass.

Pimelite.—From Silesia. Hardness = 2·0; streak white. In the forceps decrepitates at first, blackens, and fuses on the edge into a grey glass; it does not form a bead. Contains much water. With borax, in the outer flame, it dissolves slowly, and the glass is of a pale amethyst colour when cooling, but is nearly colourless when cold.

Pitchstone (Th. 392).—Johanngeorgenstadt, Saxony. Yields to the knife; streak white; hardness about = 5·5. In the forceps becomes white, and fuses on the edge into a blebby colourless glass. Contains a good deal of water. With borax it effervesces a little at first, and fuses rather slowly into a colourless glass.

Pitchstone (Th. 392).—Saxony. Resists the knife; hardness about = 6·5. In the forceps fuses readily into a brilliant dark green globule. No water. With borax it effervesces a little at first, and fuses slowly into a clear glass coloured by iron.

Pitchstone, slaty (Th. 392).—Newry. Yields with difficulty to the knife; streak white. In the forceps becomes white, and fuses on the edge into a blebby colourless glass. Contains some water. With borax fuses slowly, with slight effervescence, into a colourless glass.

Plasma.—Hard as quartz. Translucent on the edge. In the forceps becomes white, but is infusible. Contains a good deal of water. With borax, a small fragment dissolves slowly; with carbonate of soda effervesces briskly, and dissolves speedily.

Pleonaste (Black Spinel). (Th. 213; Al. 165).—Amity, New York, North America. Scratches quartz; brittle. Infusible alone. No water. With borax fuses with great difficulty.

Polymignite (Ph. 261).—Friedrichswärn, Norway. Hardness = 5·5; streak pale brown. In the forceps infusible. With borax effervesces, and fuses rather easily into a glass coloured by iron.

Prehnite (*Vide* **Edelite**). (Th. 274; Al. 110).—Resists the knife; hardness about = 6·0. In the forceps whitens; the fibres diverge; it intumesces and effervesces much, and fuses readily into a pale green transparent globule, slightly blebby. No trace of water. With borax effervesces much at first, and fuses readily into a transparent glass coloured by iron while warm. Does not gelatinize with nitric acid.

Prehnite (Th. 274; Al. 110).—Scotland. Resists the knife. In the forceps it becomes white; intumesces and effervesces much, and fuses into a colourless blebby globule. No water. With borax it fuses, with effervescence, very quickly into a colourless glass, and dissolves in very large quantity. [In microcosmic salt, dissolves more slowly than in borax, with effervescence, into a colourless bead, leaving a siliceous skeleton.—Ed.]

Psilomelane.—Glenmalure Mine, county Wicklow. Hardness = 6·0. Decrepitates when heated; infusible.

Psilomelane, botryoidal (Th. 508).—Siegen, on the Rhine. Hardness = 6·0; powder nearly black. Infusible; not attracted by the magnet after roasting. Contains a little water.

Pycnite (*Vide* **Topaz**). (Th. 254; Al. 174).—Altenberg, in Saxony. Brittle; scratches quartz feebly. In the forceps it decrepitates a little, becomes white and opaque, and is infusible. Contains no water. With borax it fuses slowly into a colourless glass.

Pyrargyllite (*Vide* **Iolite**). (Th. 238; Al. 318).—Helsingfors, in Finland. Hardness about = 3·25; yields easily to the knife; streak white. Small fragments are translucent on the edge. In the forceps cracks a little, becomes white; in a good blast it glazes on the edge. Heated with nitrate of cobalt, it becomes pale blue. Contains a considerable portion of water. With borax dissolves very slowly into a transparent glass, feebly coloured by iron while warm. Very rare.

Pyrites, cockscomb (Ph. 212).—Derbyshire. Yields with difficulty to the knife; hardness about = 6; streak greyish-black. On charcoal it blackens; emits pungent fumes, and fuses readily into a globule, rough and magnetic when cold.

Pyrolusite, acicular.—Schurde, Thuringia. Hardness = 2·5; powder greyish-black. Infusible. A trace of water.

Pyrolusite, radiated.—Soft; soils paper like Plumbago; powder nearly black. Infusible. Does not contain water. With borax it dissolves readily, and tinges it of a deep amethyst colour.

Pyrolusite, compact mamillated.—Hardness = 2·5; powder black. Infusible. No water. With borax as before.

Pyrope (*Vide* **Garnet**).

Pyrophysalite (*Vide* **Topaz**). (Th. 253; Al. 174).—Finbo, near Fahlun, Sweden. Yields to the knife; streak white. In the forceps becomes white; and, in a good heat, fuses or rather glazes on the edge. Contains a little water. With borax effervesces a little at first and fuses very slowly; with acetate of cobalt, becomes blue.

Pyroxene (*Vide* **Augite**; **Bronzite**; **Hypersthene**; **Mussite**; **Sahlite**). —Fuses readily on the surface with very slight effervescence; but forms a bead with difficulty. With borax soon indicates iron, and dissolves very slowly. The black grains from the under side fuse readily, with effervescence and intumescence, and thereby prove that the other portion has been partially fused.

Realgar (*Vide* **Arsenic, red sulphuret of**).

Rhætizite (*Vide* **Kyanite**). (Th. 241; Al. 108).—Tyrol. Yields easily to the knife. In the forceps becomes white; is infusible; and, with nitrate of cobalt, becomes blue. Almost insoluble with borax. No water.

Rhodonite (*Vide* **Allagite**; **Bustamite**).

Rhomb Spar.—Cornwall. Scratches calc spar. Effervesces feebly with nitric acid when scraped; decrepitates violently; when heated slowly, it blackens; is infusible, and does not become magnetic. With borax it effervesces briskly, and dissolves readily.

Rutile (*Vide* **Anatase**; **Brookite**; **Titanium, golden-haired**). (Ph. 254).—Killin, Argyleshire. Hardness = 5·5; streak nearly white; brittle. In the forceps infusible; with borax it dissolves very slowly into a glass of a pale amethyst colour when cold; with a larger proportion of the assay it is almost black and opaque by reflected light, and dark amethyst colour by transmitted light; in the outer flame the colour is discharged; not made opaque by flaming. With salt of phosphorus it dissolves with the greatest difficulty, requiring a very prolonged and intense heat; the glass is yellow while warm, amethyst colour when cold;—the colour is not discharged by the outer flame.

Rutile (Ph. 254).—Brocca Mountain, Luganure Mines, county Wicklow. Hardness 5·0–5·5; streak yellowish-white. A thin fragment is translucent on the edge; transmits a red colour. In the forceps it is infusible; in an intense heat glazes a little on its surface. No water. With borax very slowly soluble; the glass is colourless while warm; pale amethyst colour while cold; not made opaque by flaming; in the outer flame the colour is discharged, and it remains colourless on cooling.

Sahlite. (*Vide* **Pyroxene**). (Th. 187; Al. 143).—Tiree Island, Scotland. Hardness = 5·0; streak white. In the forceps, in the outer flame, it fuses on the edge into a green glass, slightly blebby; in a strong heat it boils a good deal, and a small fragment forms a clear green bead with difficulty. Does not contain any water. With borax emits a few bubbles; colours the glass faintly with iron; and is very slowly soluble.

Sapphirine (Th. 218; Al. 207).—Greenland. Scratches quartz feebly. In the forceps it is not altered in any respect; and a fragment is infusible in borax.

Saussurite (Th. 391).—Geneva. Very hard; almost resists the file. In the forceps it intumesces and effervesces a little, and fuses rather readily into a glass slightly blebby. No water. With borax effervesces a little, and fuses rather speedily into a glass coloured by iron.

Scapolite (*Vide* **Nuttalite; Paranthine; Wernerite**). (Th. 271; Al. 139).—Hardness about = 5·5. In the forceps intumesces and effervesces much, and fuses readily into a colourless blebby glass. With borax fuses readily, with continued effervescence, into a clear glass.

Scapolite (Th. 271; Al. 139).—Probably from Arendahl. Resists the knife. In the forceps becomes white and opaque; it intumesces and effervesces, and fuses readily into a blebby translucent globule; [soda flame—Ed.] Trace of moisture. With borax it fuses readily, with *continued* effervescence, until the assay is entirely dissolved into a colourless transparent glass; with nitrate of cobalt gives a blue glass. [With microcosmic salt dissolves readily, with continued effervescence, leaving a skeleton.—Ed.]

[**Scapolite, red.**—County Donegal. Fuses, with some difficulty, into a white opaque glass; no soda. With borax, dissolves very slowly, without any effervescence; no iron.—Ed.]

Schwarz-erz (Ph. 313).—Nagyag, Transylvania. Brittle. On charcoal fuses quietly and readily into a dark globule; and, after long roasting, yields a grain of pale-coloured copper; when heated on charcoal it deposits a white powder, which is pale yellow while warm. (Is this Zinc?)

Selenite (Th. 119; Al. 19).—Near Bonmahon, county of Waterford. Yields to the nail. In the forceps becomes white, and fuses readily into a white enamel. Contains much water. A small piece, with nearly an equal portion of powdered fluor spar, on charcoal fuses into a bead, transparent while warm, opaque when cold.

Selenite, lenticular (Th. 119; Al. 19).—Near Paris. In the forceps exfoliates, becomes white, and fuses rather slowly into a white enamel. Contains much water. With borax fuses readily into a clear glass.

[**Serpentine.**—County Galway. In the forceps fuses on the edge, with great difficulty. Contains water (8, p. c.). With borax, fuses slowly into a transparent bead coloured by iron. With microscomic salt, dissolves slowly, with effervescence, leaving a skeleton.—Ed.]

Silver, arsenical antimonial.—Hardness = 3·0; streak dark grey; fresh fracture steel grey, and fine grained. On charcoal emits copious white fumes, with some smell of arsenic at first, and leaves a bead on the charcoal, which, after long roasting, becomes malleable.

Silver, malleable Sulphuret of (Th. 641).—Sombrerete, Mexico. Sectile; cut surface shining. On charcoal it fuses very readily, and leaves a large bead of silver.

Silver Ore, dark red (Th. 648).—Abendroth Mine, Andreasberg, in the Hartz. Yields easily to the knife; streak dark red. On charcoal it decrepitates violently; but when powdered, and moistened, it is speedily reduced.

Silver Ore, dark red, massive,—Hardness about = 3·0; streak dark red; brittle. On charcoal decrepitates, and fuses very readily into a black shining globule, which is soon reduced to a globule, of pure silver; it deposits a yellowish powder at some distance from the assay.

Smaragdite (*Vide* **Hornblende**).—Hardness near 6·0; scarcely yields to the knife; powder white. In the forceps fuses, with very slight effervescence, into a green slightly blebby bead, which becomes pale blue in a strong heat. No water. With borax dissolves very slowly into a glass slightly coloured by iron.

Sodalite (Th. 257; Al. 113; Ph. 127, Jameson,* vol. ii. p. 52).—Kandgerluarsuk Fiord, West Greenland. Hardness nearly equal to Felspar; yields to the knife; streak white. In the forceps fuses with effervescence into a colourless blebby glass on the edge, which, in a prolonged blast, is converted into a white infusible scoria, probably owing to the escape of the soda. Contains a little water. With borax it fuses quickly at first, and leaves a porous skeleton, which dissolves slowly into a colourless glass. Reduced to powder, and moistened with nitric acid, it gelatinizes; dissolved in warm dilute nitric acid, it gives a white curdy precipitate with nitrate of silver, which blackens after exposure to light. While fusing, it makes a slight crepitating noise, very like carbonate of soda when fused on platina wire. I could not detect the muriatic acid with microscopic salt and oxide of copper, as recommended by Berzelius.

Sodalite (Th. 257).—Vesuvius. Colourless, and nearly transparent. It is brittle. Contains no water; and agrees with the Greenland variety in its pyrognostic and chemical characters. In the forceps effervesces little, and fuses readily into a colourless globule, slightly blebby. See Annales de Chimie et Physique, tome xxix. p. 17.

Sodalite (Th. 257; Al. 113).—Vesuvius. Of a pale green colour. In the forceps, in the outer flame, it is not affected much; in the inner flame it effervesces and intumesces much, and fuses into a transparent colourless glass, slightly blebby. No water. With borax fuses very slowly into a colourless glass. Reduced to powder, and moistened with nitric acid, does not gelatinize.

* "A System of Mineralogy," &c., &c. By Robert Jameson. Third edition, 8vo, 3 vols. Edinburgh: 1820.

Sordawalite (Th. 380; Al. 321).—Sordawala, Finland. Brittle; resists the knife. Perfectly opaque. In the forceps intumesces a good deal, and fuses, with slight effervescence, rather readily into a brilliant black bead, not magnetic. Contains some water. With borax emits a few bubbles, and fuses readily into a glass coloured by iron. No manganese.

Sphærosiderite (*Vide* **Carbonate of Iron**). (Al. 42).—Hanau, Germany. Translucent and greenish. Hardness = 4·5; streak white. Does not effervesce with cold muriatic acid; with warm acid it effervesces briskly, and is entirely soluble in it. In the forceps, when gently heated, it blackens and becomes magnetic; in the reducing flame it fuses on the edge into a shining greyish-black magnetic scoria. With borax it effervesces briskly at first, and fuses speedily into a glass deeply coloured by iron; a minute portion fused with borax, so as to tinge it faintly with the iron, and touched with a crystal of nitre, indicates, by the purple colour, the presence of a little manganese; the colour produced by the manganese may be discharged by the reducing flame

Sphærulite (Th. 395; Al. 207).—Schemnitz, Hungary. Hardness = 5·0; brittle; resists the knife. In a very strong heat it becomes transparent, and fuses with difficulty on the edge into a blebby colourless glass. Trace of moisture. With borax it is scarcely soluble.

Sphene (Ph. 258).—Sartut, in Greenland. Hardness = 5·3; streak white. In the forceps, in the outer flame, loses its brown colour, becomes yellow and translucent. In the inner flame it fuses readily on the edge, with some ebullition and slight scintillation, into a dark-coloured scoria; it does not form a bead unless the assay be very minute. No water. With borax it fuses slowly into a glass, yellow while warm, colourless when cold.

Sphene (Ph. 250).—Andernach, on the Rhine. Hardness = 5·2; streak white. In the forceps fuses rather readily on the edge into a dark-coloured glass; the colour of the unfused portion is not altered. No water. With borax it dissolves slowly into a glass, yellow while warm; in the inner flame it is yellow while warm, and brownish when cold.

Spinellane (Th. 257; Al. 114).—Jaher, near Laach on the Rhine. Hardness = 5·5; streak white. In the forceps effervesces slightly, and fuses rather slowly into a colourless blebby glass. No water. With borax fuses rather readily, with prolonged effervescence, into a colourless glass. Reduced to powder, and moistened with nitric acid, it soon gelatinizes.

Spodumene (Th. 302; Al. 109).—Killiney, county Dublin. Resists the knife; hardness about = 6·0. In the forceps, when gently heated, it becomes white and very brittle; [and glows brilliantly—Ed.;] curls up and fuses, with very slight intumescence, into a number of small globules, which require a good blast to unite them in a clear blebby bead. Contains no water. With borax fuses readily at first, leaving a transparent skeleton, which dissolves slowly. At the moment it fuses, it tinges the flame behind the assay carmine-red (proof

of lithia), particularly if the point of the inner flame be let play over the edge of the assay; it is not so readily observed if the assay be entirely enveloped in the flame.

Spodumene (Th. 302; Al. 109).—Dalkey Quarry, near Dublin. Resists the knife. In the forceps intumesces, and fuses, with slight effervescence, into numerous small globules, which unite in a strong heat, and form a blebby globule. No water. With borax dissolves rather slowly.

Steatite (Th. 329; Al. 97).—Rathlin Island, Antrim. Yields easily to the nail; cuts like wax. In the forceps becomes white, and in a strong heat fuses on the edge into a white blebby enamel; a very small fragment forms a bead. Contains much water. With borax slowly soluble [with effervescence.—Ed.].

Steatite (Th. 329; Al. 97).—Gue Grace, Lizard Point, Cornwall. Sectile; does not yield to the nail. In the forceps it fuses rather readily on the edge, with some effervescence, into a white enamel, and a small fragment forms a bead with difficulty. Contains a little water. Dissolves slowly with borax.

[The Steatite of Gue Grace occurs as a Sahlband between the Serpentine porphyry and the Granite veins that penetrate it; it derives its magnesia from the Serpentine, and its alumina from the Granite; the Steatite commonly found in Granite veins, at Luganure and Ballycorus, in the Wicklow and Dublin mountains, contains no magnesia, and is not so soft or fusible as that found in Basalt at Rathlin Island, and it contains less water.—Ed.]

Stilbite, red.—(Th. 344; Al. 125).—Scotland. Yields easily to the knife. In the forceps becomes white; exfoliates, curls up, and fuses into a white blebby globule. Contains much water. With borax it effervesces, and dissolves very rapidly into a colourless glass. [Dissolves readily in microscomic salt, leaving a skeleton.—Ed.] Does not gelatinize with nitric acid.

Stilbite.—Benevenagh, county Derry. Its characters are the same as last.

Strontian, brown carbonate of (Th. 108; Al. 46).—Strontian, Argyleshire. Its pyrognostic characters same as those of the Carbonate.

Strontian, carbonate of (Th. 107; Al. 46).—Golden Bridge, near Dublin. Yields easily to the knife. Effervesces briskly with muriatic acid, and is entirely soluble in it. In the forceps throws out a white cauliflower-like excrescence, tinges the flame behind the assay deep carmine-red, and is infusible. No water. With borax it effervesces much, and fuses very speedily, and in large quantity, into a glass, which is opaque when cold, if saturated.

Strontian, green carbonate of (Th. 107; Al. 46.).—Strontian, Argyleshire. Its pyrognostic characters same as those of the Carbonate.

Strontian, sulphate of (Th. 109; Al. 49).—Bristol. Hardness about = 3·0. In the forceps a large piece decrepitates; a small fragment fuses easily into a white enamel; and when well roasted, it tinges the flame behind the assay carmine-red; but not so strong as the carbonate of Strontian. No water. With borax fuses readily, and in

large quantity, into a glass which becomes opaque when cold, if saturated.

Sulphate of Lime, compact hydrous.—Hardness less than calcareous spar. In the forceps fuses readily into a white opaque globule, which boils a little if intensely heated. Contains much water. With borax dissolves very readily into a clear glass, which becomes opaque when cold, if a sufficient quantity of the assay be used.

Table Spar (*Vide* **Wollastonite**). (Th. 129; Al. 152).—Cziklowa, in the Bannat, Temeswar. Does not effervesce with muriatic acid. Yields to the knife. In the forceps fuses, with slight effervescence in the inner flame, into an opaline globule. Contains a little water. With borax fuses slowly into a colourless glass. Dr. Thompson gives the name of Wollastonite to a different mineral (*Qu.* Stellite).

Table Spar (Th. 129; Al. 152).—Hardness about = 3·5. Does not effervesce with nitric acid. In the forceps decrepitates slightly, and fuses readily into a white enamel; in a strong heat it effervesces a little. No water. With borax dissolves readily into a transparent colourless glass.

Table Spar (Th. 129).—Does not effervesce with acid. Hardness about = 4·0. In the forceps it fuses on the edge into a semi-transparent glass, and forms a bead with some difficulty in a prolonged blast. With borax effervesces a little at first, and fuses rather slowly into a colourless glass.

Talc (Th. 357; Al. 90).—St. Stephen's, Cornwall. Yields easily to the knife. In the forceps fuses readily, with some intumescence and effervescence, into a brownish black scoriaceous bead, feebly magnetic. With borax fuses readily, with effervescence, into a glass coloured deeply by iron.

Talc, indurated (Al. 91).—Shetland. Hardness about = 4·0; streak white. Sectile in a low degree. In the forceps fuses, with great difficulty, on its thinnest edges. Trace of moisture. With borax emits a few bubbles, tinges it with iron, and dissolves very slowly. [With microcosmic salt, intumesces and dissolves, leaving a siliceous skeleton.—Ed.]

Talc, Venetian (Th. 186).—Tyrol. Flexible, sectile. Yields to the nail. In the forceps exfoliates and fuses on the edge into a white enamel. No water. With borax effervesces much, dissolves speedily, and in large quantity, into a clear glass not rendered opaque by flaming. Not soluble in hot nitric acid.

Tantalite (*Vide* **Columbite**). (Ph. 272; Th. 484).—Connecticut, North America. Hardness about = 5·25; streak pale reddish-brown. In a good heat it fuses on the edge into an iron-grey glaze; not attracted by the magnet. No water. With borax fuses very slowly into a glass slightly coloured by iron; if saturated, the bead becomes greyish by flaming, and nearly opaque; with borax and nitre gives a trace of manganese. With salt of phosphorus dissolves slowly into a glass coloured by iron while warm; does not become red when cold; therefore, does not contain Tungsten.

Tennantite (Th. 630).—Huel Damsel Mine, St. Day, Cornwall. Brittle; yields easily to the knife; powder dark-grey. On charcoal does not decrepitate; when first heated, it burns with a pale blue flame round the assay; fuses readily; emits sulphurous acid fumes and an arsenical smell for a short time. The fused scoria is attracted by the magnet. When well roasted, a grain of copper will be found on breaking the assay.

Thomsonite (*Vide* **Chalilite**). (Th. 314; Al. 124).—Kilpatrick, near Glasgow. Yields to the knife; hardness about = 5·0. In the forceps it becomes white, exfoliates, intumesces, and fuses readily into a white bead, which, if intensely heated, effervesces a little, and becomes nearly transparent and colourless. Contains water. With borax effervesces a little at first, and fuses readily into a colourless glass. Gelatinizes readily with nitric acid. Thompson says, "it does not melt."

Thomsonite (Th. 314; Al. 124).—From the neighbourhood of Glasgow. Scarcely yields to the knife; hardness about = 5·0–5·2. In the forceps becomes white, intumesces, and fuses, with slight effervescence, into a blebby, semi-transparent, colourless bead. Contains much water. With borax effervesces a little at first, and fuses speedily into a colourless glass, leaving a small skeleton which dissolves slowly. Gelatinizes readily with nitric acid.

Tin, cupreous sulphuret of (Th. 586).—St. Agnes, Cornwall. Hardness = 3·0; streak blackish. On charcoal emits slight sulphurous smell, and fuses very readily into a magnetic bead. Yields copper after long roasting.

Tin, oxide of (Th. 585).—Saxony. Yields with difficulty to the knife; hardness = 6·0; streak white. On charcoal it decrepitates, and in a good reducing flame it yields a malleable globule, brilliant while hot, dull when cold, on account of its rapid oxidation.

Titanium, golden-haired (*Vide* **Rutile**).—Piedmont. Infusible. With borax effervesces briskly at first, and fuses rather slowly into a transparent glass, which is colourless if the assay be small, but, if the proportion of the assay be increased, the glass is yellowish-green while hot, and blackish-brown while cold, by transmitted light; and if saturated, becomes white by flaming. With salt of phosphorus, it effervesces briskly at first; gives a glass, yellow while hot, then greenish, and finally a pale amethyst colour when cold; and leaves a residuum which dissolves very slowly.

Topaz (*Vide* **Pycnite**; **Pyrophysalite**).

Tourmaline, black.—Bovey Tracey, Devonshire. Resists the knife. In the forceps it fuses readily, with intumescence and effervescence, into a dark-coloured slag. No water. With borax it effervesces, breaks up, and fuses quickly into a glass coloured by iron.

Tourmaline, black.—Land's End, Cornwall. Fuses readily, with much intumescence and effervescence, into a black bead. With borax effervesces and fuses readily into a glass coloured by iron. [With salt of phosphorus dissolves readily, leaving a skeleton of silica; bead

cherry-red when hot, green on cooling, and colourless when cold.—Ed.]

Tourmaline, green.—Chesterfield, America. Resists the knife. In the forceps it fuses on the edge, with slight intumescence, into a greyish-white rough enamel. No water. With borax it effervesces at first, breaks up, and fuses quickly into a clear glass, coloured by iron while warm; with nitrate of potash, manganese is made apparent.

Tourmaline, green.—Killiney, county Dublin. Characters same as last: not so much manganese.

Tremolite, asbestiform (Th. 194; Al. 147).—Camborne, Cornwall. Hardness = 4·5. In the forceps fuses, with difficulty on the edge, into a greenish glass, with scarcely any effervescence. No water. With borax emits some bubbles, and fuses slowly into a colourless glass.

Tremolite, crystallized (Th. 194; Al. 145).—St. Gothard. Hardness about = 5·0. In the forceps, in the inner flame, fuses on the edge, with some effervescence and intumescence, into a blebby white glass, rendered more transparent in a strong heat; and a small fragment forms a bead with difficulty. No water. With borax emits a few bubbles, and fuses rather readily into a glass slightly coloured by iron.

Triphyline.—Bodenmais, Bavaria. Hardness about = 5; streak white. In the forceps fuses readily into an iron-black globule, feebly attracted by the magnet; in a stronger heat the assay spreads over the points of the forceps; heated with some of Turner's test (bisulphate of potash four and a half parts, fluor spar one part) it tinges the flame red. Contains very little water. With borax dissolves speedily into a glass deeply coloured by iron. With nitre it indicates manganese.

Turquoise (*Vide* **Calaite**).

Uranium, oxydulous (Th. 268).—Hardness = 5·5; streak black. Infusible; glazes a little in a strong heat. Contains a good deal of water. With borax it emits some bubbles, and dissolves readily; in the outer flame it is greenish, and contains numerous black floculi; in the inner flame it becomes clearer and of a darker colour.

Voltzine (*Vide* **Zinc oxysulphuret**). (Th. 540).—Lanescot Mine, Cornwall. Hardness = 5·0–5·5; streak white. Decrepitates violently even when reduced to powder and moistened; it deposits on the charcoal a powder, yellow while warm. Contains no water. With borax it breaks up into minute pieces, and dissolves slowly into a glass, colourless while warm, which exhibits milky streaks when cold; by careful flaming it may be made more opaque; in the inner flame it remains transparent when cold, and cannot be made opaque again without a fresh portion of the assay being added. Rare. This appears to be the mamillated blende of Phillips; see his Mineralogy, Third Edition, page 353.

Wavellite (Th. 308; Al. 24).—Clonmel, Tipperary. Yields to the knife; hardness about = 4·0; streak white. In the forceps it becomes white; the fibres diverge, but are infusible. Gives out a good deal of water. With borax fuses readily into a colourless glass, in large quantity; with nitrate of cobalt, becomes blue.

Wernerite (*Vide* **Scapolite**). (Th. 271; Al. 139).—Arendahl, Norway. Hardness about = 5·0. In the forceps fuses readily, with intumescence and effervescence, into a colourless blebby glass. No water. With borax fuses readily, with continued effervescence, into a clear glass.

Withamite (Th. 376; Al. 156).—Glencoe, Argyleshire, Scotland. Nearly as hard as Felspar; streak white. Translucent in thin fragments. In the forceps fuses readily, with intumescence and effervescence, into a dark-coloured slag, which melts with some difficulty, on the edge into a black shining glass. No water. With borax fuses readily into a glass coloured by iron while warm; with nitre it indicates the presence of a little manganese.

Wollastonite (*Vide* **Table Spar**). (Th. 130).—Kilsyth, Scotland. Yields to the knife. In the forceps fuses readily into a transparent colourless globule, which effervesces a little in a strong heat. Trace of water. With borax fuses readily, with slight effervescence at first, into a colourless glass, and dissolves in large quantity.

Zinc, blue siliceous oxide of.—Catherinenberg. Hardness = 4·5; streak white. Does not effervesce with muriatic acid. In the forceps it tinges the flame a fine bright green; intumesces, and fuses on the edge into a white enamel. Contains a good deal of water. With borax it fuses speedily, with effervescence, and in large quantity, into a clear glass, and does not become opaque on cooling, even when saturated.

Zinc, carbonate of.—Hardness = 4·5; streak white. Effervesces with nitric acid. In the forceps becomes yellow while hot, and deposits a powder on the points of the forceps, yellow while warm, white when cold; glazes on the edge. With borax gives a transparent bead, yellow while hot.

Zinc, carbonate of.—Siberia. Hardness = 4·5; streak white. Effervesces with nitric acid when scraped. In the forceps becomes opaque and yellow while hot. Infusible, but is slowly vaporized. Very fine.

Zinc, oxysulphuret (*Vide* **Voltzine**).

Zinc, pale blue silicate of.—Cumberland. Hardness = 4·5; streak white. In the forceps intumesces a little, tinges the flame greenish, and is infusible; it is pale yellow while warm, and white when cold. Contains a little moisture. With borax it dissolves very slowly. With acetate of cobalt it turns blue.

Zinc, silicious oxide of.—Ziklowa, in the Bannat. Specific gravity = 3·36. Hardness = 5·0; streak white. In the forceps small fragments fly off; it becomes opaque, white, and brittle; while hot it is yellow,

and tinges the flame pale green, and fuses on the edge into a white enamel. No water. With borax it effervesces at first, and dissolves rather readily into a transparent glass, which is pale yellow while warm, and does not become opaque by flaming, even when saturated. With salt of phosphorus it fuses into a transparent bead, which becomes opaline on cooling, and a portion remains undissolved. Reduced to powder it gelatinizes in muriatic acid in a few minutes.

Zinc, white carbonate of.—Catherinenberg, Siberia. Hardness about = 4·0. Effervesces briskly with muriatic acid. In the forceps infusible, but becomes yellow while warm. No water. With borax it fuses, with prolonged effervescence, into a transparent glass, which, when saturated, becomes opaque on cooling.

Zoisite (*Vide* **Epidote**) (Th. 270; Al. 150).—From Williamsburg, Massachussets, North America. Hardness nearly equal to quartz. In the forceps fuses readily, with intumescence, into a pale green scoria, which glazes on its surface in a very strong heat. No water. With borax fuses readily, with effervescence, into a transparent bead, coloured by iron while warm.

Zoisite (Th. 270; Al. 150).—From Saxony. Resists the knife; hardness about = 7·0. In the forceps it intumesces, effervesces, and fuses readily into a pale green scoria. No water. With borax it dissolves speedily, with effervescence, into a transparent glass, coloured by iron while warm.

Zoisite (Th. 270; Al. 150).—From Strabane, county Tyrone. Resists the knife. In the forceps fuses into a dark green slag. No water. With borax it breaks up, and fuses readily into a clear glass coloured by iron while warm.

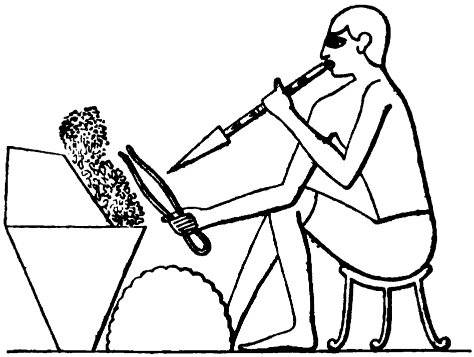
Zoisite.—Pfitch, Tyrol. Resists the knife; hardness = 7·0. In the forceps intumesces, effervesces, and fuses readily into a pale green scoria. No water. With borax it dissolves speedily at first, and leaves a residue more slowly soluble; the glass is coloured by iron.

XXXII.—On the Blowpipe, its History and Use. By Aquilla Smith, M.D., Fellow of the King and Queen's College of Physicians in Ireland.

[Read before the Geological Society of Dublin, June 18, 1860.]

The Blowpipe is an instrument by means of which the flame of a lamp or candle may be concentrated, so as to communicate a very intense heat to small bodies placed within the flame. Although this instrument was employed in the arts by the ancient Egyptians about 1500 years before our era, and in more modern times has been used for various purposes, particularly by goldsmiths and jewellers in the soldering of metals on a small scale, whence it derives its name in the German language, "Lothrohr," from "Lothen" to solder, and "rohr" a tube or pipe, it is scarcely more than a century since the idea of applying it to mineralogical purposes was conceived.

The accompanying woodcut is taken from Rosellini, and represents an Egyptian silversmith using the Blowpipe. It was found in a Theban tomb, in conjunction with representations of workers of gold.



The following description of this remarkable figure is given by Rosellini:—

"L'artefice sta seduto dinnanzi ad un fornello posto in una vasa di terra, nel quale, mentre soffia con un tubo di canna armato in cima di metallo per difesa dal fuoco, sembra prendere o aggiustar colle môlle la materia che fonde, o che arroventa. A' suoi pede è figurato un mucchio che par d' argilla, della quale usano i fondatori de' metalli, o per forme, o per altre bisogne dell' arte loro."—*Rosellini. I Monumenti dell' Egitto e della Nubia. Parte seconda. Monumenti Civili.*—Tom. ii., p. 292; Tavola lii., fig. 4.

Bergman informs us that, about the year 1738, Andrew Swab, a Swedish metallurgist, and Counsellor of the College of Mines, was the first to employ this simple and elegant instrument for the purpose of assaying metallic minerals. He, however, left no work on the subject, and it is unknown to what extent his researches with this instrument were carried. The subject does not appear to have received any particular attention from any-one until Cronstedt, a Swedish nobleman, in 1758, proposed his system of mineralogy, in which the arrangement is dependent on the chemical composition of the minerals. In order to recommend the general adoption of his system, it became to him a matter of great importance to possess some ready and simple means of determining the constituents of mineral bodies, as it was evident that the slow and laborious operations of chemical analysis could not be generally employed by mineralogists. He found the object of his pursuit in the Blowpipe; and by the employment of fluxes in the experiments performed with this instrument, he may be considered as the founder of a new mode of investigation in chemical science. He used the Blowpipe to distinguish mineral substances from one another, by the means of fusible reagents, whose actions

should produce such modifications on the objects to which they were applied as might afford some conclusions respecting their composition, and serve as a basis for the classification he adopted. He carried the use of the Blowpipe to a degree of perfection that could only have resulted from the most persevering industry. The results obtained by him are to be found in the first edition of his "System of Mineralogy," published in Sweden, in 1758, a translation of which into English, by his pupil, G. von Engeström, was published in 1765. The last edition is that by J. H. de Magellan, 2 vols., 1788.

The employment of the Blowpipe, being thus brought into notice, excited the attention of chemists and mineralogists to the use of the instrument, who, however, derived little advantage from it, except as a means of ascertaining the fusibility of bodies, and occasionally their solubility in borax; for the want of skill in its application, which can only be acquired by patience and practice, prevented a just estimate of its value being formed.

In Sweden, however, it appears to have been cultivated with the greatest success; and it is to the chemists and mineralogists of that country that we are indebted for the greater portion of the information we possess on this subject, particularly to Bergman, Gahn, and above all to Berzelius.

Bergman extended the use of the Blowpipe by a series of original researches, in which he investigated the properties of most of the then known species of minerals, and applied it to the field of inorganic chemistry, in discovering very minute portions of metallic matter in analytic researches; and published the result of his observations at Vienna, in 1779, in a treatise under the following title: "De Tubo Ferruminatorio, ejusdemque usu in explorandis Corporibus, præsertim Mineralibus;" a translation of which into English will be found in the 2nd vol. of Bergman's Physical and Chemical Essays, by Dr. Edmund Cullen, Lond., 1788.

The close and continued application which Bergman bestowed on his studies had such an effect on his health, as to oblige him to continue his philosophical pursuits with the help of an assistant. He accordingly employed Assessor Gahn, who performed, under his directions, a series of operations on all the minerals then known, by which he was taught in what manner each individual conducted itself before the Blowpipe. The experience thus acquired enabled Gahn to employ the instrument in every kind of chemical and mineralogical inquiry; and he attained such a degree of skill in its use, that he could detect the presence of substances in a body by its means, which had escaped the most careful analysis, conducted by the ablest chemists of those times. Gahn was indefatigable in his observations and experiments with the Blowpipe, without which he never travelled; and though he was led to contrive several improvements in its application, which were imagined and executed with such sagacity and precision that his results were entitled to the greatest confidence,—he appears never to have thought of publishing an account of his labours, which no doubt would have been of great importance.

As an instance of his power of detecting the presence of metallic bodies, we are told by Berzelius that he had often seen him extract from the ashes of a quarter of a sheet of paper distinct particles of metallic copper, and that too before the knowledge of the occurrence of this metal in vegetables was known, and therefore before he could have been led from this circumstance to suspect its presence in paper.

Although we cannot but feel regret at having received no work from a man so eminently qualified to instruct on this subject as Gahn, still we must consider it fortunate, that, under such circumstances, the knowledge and experience of so long and laborious a life has not altogether been lost. Fortunately for science, accident, as it were, made Berzelius the medium through which this information was to be communicated to the world, and it must be universally felt and acknowledged that he has most ably fulfilled the task assigned to him. The zeal and assiduity of Gahn in this study, together with the circumstances to which we are indebted for the preservation of his labours, are told in an interesting manner by Berzelius, in his treatise on the Blowpipe.

Such, then, is the origin of Berzelius' treatise, a work which has been acknowledged as the highest authority on this subject by almost every writer on mineralogy, for the last 20 years. An English translation of the French edition, by M. Fresnel, was published by Mr. Children in 1822.

We have now given as full an account of the rise and progress of the Blowpipe, in its application to mineralogy, as the nature of the subject will admit; and before we conclude this part of our subject, we feel called on to show that the use of this valuable little instrument was not as much neglected in England as we might be led to suppose from an assertion made by Berzelius, at the close of his history of the Blowpipe:—"In all the rest of Europe only one naturalist, but he a very distinguished one, has applied himself to the study of the Blowpipe and its uses, and submitted a large number of mineral substances to its test: this was H. de Saussure." Some years previous to the publication of Berzelius' work, Mr. Arthur Aikin, the author of a Manual of Mineralogy, the second edition of which was published in London in 1815, had arranged all mineral substances according to their habitudes before the Blowpipe, yet it must be admitted that it was applied by him in a limited manner: for in many instances he only states the degree of fusibility of the mineral, and occasionally its colour after fusion, rarely noticing the minute details which are so useful, as in many instances offering most satisfactory characteristics, particularly when the aggregate of the characters are taken into consideration. And although Dr. Wollaston has never communicated his knowledge on this subject to the world, it is well known that he was eminently distinguished for his dexterity in managing this useful little instrument; and in later times Mr. Children and the late Dr. Turner made many important discoveries respecting the use of reagents with the Blowpipe.

I.—Description of the Blowpipe.

Blowpipes are of two kinds, *simple* and *compound*. A simple Blowpipe consists merely of a conical tube, generally made of metal, through which air is blown from the mouth of the operator. A compound Blowpipe consists of a tube through which common air or gas of some kind is blown by some secondary apparatus, to which the tube is attached.

As our object is to simplify, as much as possible, the application of the Blowpipe to the purposes of the practical mineralogist, we shall only describe the one we have found to answer best, and for the descriptions of the various kinds, both simple and compound, refer to the work of Berzelius, or the useful little manual "on the Use of the Blowpipe," published by Mr. Griffin of Glasgow.

The instrument we have always used is that invented by Dr. Wollaston; it is made of copper, and consists of three pieces, two of which, when united, form the tube, about seven inches in length, the widest extremity of which constitutes the mouth-piece, and is plated, to prevent the disagreeable taste which copper would produce in the mouthof the operator. The third part, or nozzle, which when fitted on the smaller end of the tube forms a right angle with it, is sometimes constructed so as to form an oblique angle with the tube, which, in our opinion, is not as convenient as the former. The nozzle is also sometimes made of platina. We have, however, used one of brass for some years, and it is as good now as when first it was made.

This instrument is very light, so that the operator can, when occasion requires, hold it steadily between his teeth while blowing, and enjoy the use of both his hands for a time, and for portability it far exceeds all others; for when the instrument is not in use, the nozzle fits into the open extremity of the second piece, and the latter within the mouth-piece; in this form its length is reduced to less than four inches, and it occupies no more room than a pocket pencil-case. One inconvenience attends the use of this instrument, that is, the condensation of the vapour of the breath in the interior of the tube; and contrivances have been made to obviate this, by attaching a hollow chamber to some part of the tube to collect the condensed vapour. In our opinion, this trifling objection, which can at all times be readily removed by inverting the tube or blowing forcibly through it, is not at all compensated for by the addition of the chamber, which adds considerably to the weight of the instrument.

II.—The Combustible or Flame.

A great diversity of opinion exists respecting the material which should be used to produce the flame for the Blowpipe: wax, oil, and tallow have been recommended; we have always preferred a candle made of pure wax, about an inch in diameter, with the wick rather thick in proportion to the size of the candle; it is far more cleanly than tallow or oil, burns with a clear flame, does not emit any disagreeable odour, and affords a heat sufficiently intense. The candle should never be more

than about six inches in length; and we have found advantage in using a supporter made of tin plate, to the socket of which is attached a stem about three inches long, which is made to slide in a tube of the same length, attached to the foot of the supporter. By means of the sliding socket, the flame of the candle can always be kept at nearly the same elevation from the table, at a height most convenient to the operator.

III.—Method of Blowing.

The operation of keeping up a continued and steady stream of air through the Blowpipe, simple as it seems, is difficult at first; the whole artifice, however, consists in this, that while the operator breathes through his nostrils, he must blow the air contained in his mouth by the mere compression of the cheeks; to accomplish which, the first thing to be done is to acquire the habit of breathing easily, and without fatigue, through the nostrils alone, while the mouth is filled and the cheeks inflated with air; when this is acquired, the Blowpipe may be put into the mouth, and the confined air expelled through the tube by means of the muscles of the cheek. As soon as the air is nearly exhausted, the expiration from the lungs, instead of being made entirely through the nostrils, is to be partly forced into the cavity of the mouth: all subsequent supplies of air are to be introduced in the same manner as the first. Thus, with a little practice, the power may be obtained of keeping up a continued blast for as many minutes as may be necessary for any ordinary operation.*

IV.—Of the Blast and Flame.

Having accomplished the first object of keeping up a steady blast, the next requisite is to produce a good heat: this is best attained by keeping the wick of the candle of a moderate length, and avoiding all drafts or currents of air, which would render the flame unsteady. The point of the Blowpipe should be held just above the wick; and as soon as the blast is directed on the flame it will be observed to assume a conical form, and to consist of two parts, an outer and inner, the latter of a light blue colour, converging to a point at the distance of about an inch from the nozzle; the former of a yellowish colour, and converging less perfectly. The most intense heat will be just at the point of the inner flame.

To attain the maximum degree of heat, we must neither blow too strongly nor too gently; and we should bear in mind that our pyrognostic operations are not confined to obtaining the highest possible temperature; other phenomena must be produced, which require a less intense heat. A very important point in pyrognostic assays is the power of

* It is generally supposed that it is a matter of some difficulty to use the Blowpipe—that it requires great pulmonary exertion, and may on this account be injurious to the health. Such, however, is not the case, as the experience of half an hour will convince any person, under the direction of a skilful teacher.

producing at will the phenomena of oxidation and reduction, both of which are easily effected, although diametrically the reverse of one another.

1. *Oxidation.*—Oxidation goes on most actively at an incipient red heat; and the further we recede from the flame, the better the oxidation is effected, provided we can keep up a sufficient heat. The opening in the nozzle of the Blowpipe, we are told, should be larger for this operation than in other cases: however, we have always succeeded with the ordinary nozzle we use for all purposes; and which in this case answers very well, by holding it a little further from the flame.

2. *Reduction.*—Reduction or de-oxidation is best effected in the brilliant part of the flame, immediately beyond the point of the inner blue flame, and it requires more expertness in the operator than the very simple process of oxidation. A very good mode of acquiring the art of making a good reducing flame is to fuse a small portion of tin on a piece of charcoal, so that its surface may always retain its metallic brilliancy: tin has so great a tendency to oxidation, that the moment the flame begins to become an oxidating one, it is converted into an oxide of tin, which covers the metal with an infusible crust.

V.—Of the Support.

The assay, or substance to be examined by the Blowpipe, must necessarily rest on a solid body, or be fixed in a steady position by some means; and the material or instrument by which this is effected, is called the Support, of which there are two kinds, the combustible and incombustible.

1. *Combustible Supports.* The combustible support generally used is charcoal, and that prepared from the light woods in general answers best; and as it is not always easy to obtain charcoal which possesses all the qualities which it should possess, we shall detail the manner of preparing such as we have found to answer very well.

Take pieces of white pine-wood of a fine grain and free from knots, about six inches in length, and an inch or more square; place them in a large common crucible, and cover them with fine sand; then place the crucible in the centre of a strong fire, and leave it there until the wood is perfectly charred, which will take place in about an hour. The crucible should then be removed from the fire, and allowed to cool slowly; and when cold, the charcoal will be ready for use. When well prepared, it should be perfectly black, very light, possess some lustre, and be easily broken across the grain; that which splits, scintillates, smokes, or emits flame when heated, is not of good quality.

Mr. Children recommends alder wood, as possessing all the necessary qualities to make good charcoal.

Charcoal is chiefly used in the examination of the metallic ores when our object is to reduce them, because it attracts the oxygen from the oxide, and thereby accelerates reduction to the metallic form. The intensity of the heat may be greatly increased by making a cavity for the assay in the charcoal, and covering it with another piece of charcoal,

which by reverberating the heat converts it into a reverberating furnace of great intensity.

Gahn* directs that a small hole should be made in the charcoal, and into this hole the substance to be examined must be put. The assay should be placed on the side of the charcoal, and not the end; otherwise, the substance to be fused spreads about, and a round bead will not be formed. But Berzelius, in the following passage, gives us directions quite contrary (p. 31):—" In order to fix the flux to a point on the surface of the support, one of the ends perpendicular to the layers of the wood is to be chosen for its receptacle; *if placed on the section parallel to the layers, it would spread over the surface.*" We have occasionally used both methods, but prefer placing the assay on the side of the charcoal; however, a little experience will be the best guide for the experimenter.

2. *Incombustible Supports.—Platinum Wire.* The only incombustible substance used as a support which it is necessary to notice is platina, which, from the difficulty of fusing it even in a very high temperature, its malleability, and property of conducting heat very slowly, render it preferable to any other material.

Platinum Forceps.—One of the greatest advantages of this instrument is, that it enables us to fix the object of experiment in a steady position; and by this means a very minute fragment, which it would be impossible to keep fixed on charcoal, can be examined with great advantage.

The chief advantage of this instrument is that it enables the operator to submit a mere fragment of a mineral to a high and uniform temperature, which could not be effected on charcoal, as the assay would be blown away the moment the jet fron the pipe would be directed on it. Hence we have found several minerals which on charcoal were apparently infusible, yet when placed in the forceps, and submitted to a well-directed flame, fuse without difficulty on the edge; and besides it enables us to observe the effect of the assay on the flame, in producing certain colours which are very characteristic of some minerals, as Carbonate of strontia and Lepidolite, which tinge the flame red; Cyprinei and Boracite, which impart a green colour.

The forceps may be used with advantage in the examination of all the earthy and many of the metallic minerals, particularly such as are refractory on charcoal. We should, however, be careful not to employ it as a support for those metallic oxides and compounds which are reducible *per se* before the Blowpipe, and readily form an alloy with platina.

The forceps are used for holding a small portion of a mineral, when we wish to try its fusibility. The most convenient form of this instrument consists of two thin plates of steel, each having a piece of flattened platina about the sixteenth of an inch wide riveted on its extremity. The platina points should possess as little bulk as possible, in order that

* *Vide* Thompson's "Annals of Philosophy," vol. xi., p. 40, on the Blowpipe, from a treatise on the Blowpipe by Assessor Gahn, of Fahlun, by Dr. Ure, as Mr. Griffin informs us.

little heat may be abstracted. These plates are fastened in the middle to a small piece of iron or brass, somewhat of wedge-shape, so that the platina extremities are held in close apposition by the spring of the steel plates, while the other extremities are separated about a quarter of an inch, and may be used as an ordinary spring forceps. The platina extremities are opened by pressing the fore-finger and thumb against two small buttons, the shank of each of which is fixed in one plate, and passes through the other.

VI.—Additional Instruments.

Under this head we arrange all those instruments which are used for various purposes, subservient to the examination of minerals.

1. *The Common Steel Cutting Pliers*—Is very useful for detaching small portions from a specimen, without the risk of injuring it by the concussion which would be caused by a hammer.

2. *A small Jeweller's Hammer*—Is also useful for detaching fragments for examination from specimens, and for ascertaining the malleability of the globules obtained from metallic minerals.

3. *A small Anvil*—Is used for crushing pieces of minerals, which are to be wrapped in paper, in order to prevent the dispersion of the fragments, and also for trying the malleability of metals. We have preferred a small smoothing-iron, the face of which has become *black* by oxidation, the advantage of which will be pointed out hereafter.

4. *A Pocket Knife*—With well-tempered blades, is an indispensable instrument for trying the hardness of minerals, which is estimated by the resistance they oppose to it. It may also be applied for the purpose of mixing a pulverized mineral in the palm of the hand with water or the fluxes.

5. *A Small Triangular File*—Is requisite to test the degree of hardness of such minerals as resist the knife, and also for the purpose of cutting glass tubes, &c.

6. *A Small Agate Mortar and Pestle*—For the purpose of pulverizing the harder minerals, and separating minute metallic globules from the charcoal on which they have hardened; and a piece of pumice-stone should be at hand, to remove the traces left on the surface of the mortar by the trituration of metallic substances.

7. *A Pocket Microscope*—Containing three glasses of different powers, which may be combined if necessary, is perhaps the most convenient.

VII.—Of the Size of the Assay, and its Preparation for Examination by the Blowpipe.

1. *Size of the Assay.*—The fragment of the substance submitted to the Blowpipe for examination is termed the *Assay*, and it is a matter of the greatest importance in pyrognostic experiments that some definite size for the assay should be agreed on by experimenters. Mr. Mawe tells us that "the piece of mineral to be examined should not in general be larger than a *peppercorn.*" Dr. Ure (Chemical Dict., art. Blowpipe) says that "it should

not exceed the size of half a peppercorn." Bergman, however, with whom the specification of this bulk originated, observes "that we must often operate on smaller portions." Von Engeström recommends a piece about the size of a cube one-eighth of an inch on the side. Now, it may be safely asserted, that no correct or extended set of experiment on minerals with the common Blowpipe could be made on pieces nearly so large; and that no person using the Blowpipe for the first time, could make any impression on a piece of that size, unless he happened to meet with a very fusible substance. It is probable that many persons (and I have known instances myself), have failed in their attempt to use the Blowpipe, by using an assay of too large a size; for nothing can be more evident, than that if the assay be large, a part of it must necessarily be out of the force of the flame, which is very small, and must therefore tend to cool the part immersed in the flame; the consequence of which is, that the heat is carried off, and the operator will be tired before the assay is in the least affected, unless it be very fusible indeed.

Mr. Aikin, who published his Manual of Mineralogy in 1813, was the first who perceived the necessity of operating on pieces of very small bulk; and recommends that the size of the assay "*should scarcely exceed the bulk of a pin's head*," which is perhaps as good a type of the size as could be given.

Berzelius says, "As to the size of the morsel operated on, it is large enough, if we can distinctly see the effects produced on it; and we are more likely to fail in our object by using too large, rather than too small a piece;" and adds, that "a piece of the size of a large grain of mustard-seed is almost always sufficient," and that "the only instance in which it may be convenient to operate on portions larger than a mustard-seed is when we wish to extract metals, because in that case we obtain a larger portion of the metal sought for, which may consequently be examined and distinguished with greater ease."

In the first experiment the assay should never exceed the size assigned by Aikin; for unless we attend particularly to this, we can never arrive at uniform results, or institute comparisons which would be of any value. There are many minerals which, if used the size of a peppercorn, which has been recommended by most authors, would be altogether infusible by the means we adopt, yet a small fragment of the same substance will be fused without any difficulty. When we have ascertained that a mineral is easily fused, it is often desirable to operate on a larger piece in metallic minerals. If we find a fragment infusible in the first attempt, we should select another with a thin edge, and submit it to the most intense heat we can produce; and in this way we sometimes succeed in fusing the thin edge of an assay which, under other circumstances, might be pronounced infusible: in such cases we should always examine the edge of the assay with the microscope. Minerals sometimes occur in very minute grains or pulverulent (as Iserine) which cannot be heldi n the forceps; and if they cannot be retained on charcoal, the only mode of proceeding then is to reduce them to powder,

and form it into a paste with a little water in the palm of the hand, and then place it on charcoal, when in some cases it will form a cake, which may then be held in the forceps, if necessary.

2. *Preparatory Examination.*—When we are about to enter on the examination of a mineral substance, we do not begin immediately with the Blowpipe: a few very simple preliminary experiments are first to be made, by which the succeeding steps of the examination may be directed.

As it is a matter of some importance to save trouble, and, above all, time, we shall state the manner in which we have been in the habit of proceeding. Our first care should be to select a homogeneous particle, which will be a matter of no difficulty, if the mineral be crystallized; and should it be amorphous, a magnifying glass becomes necessary, to discover any heterogeneous matter, should it exist, for minerals do not always consist of the same substance throughout, although they may appear so to the unassisted eye. Next we ascertain the degree of hardness, by scratching it with a knife; and if it resists this, we resort to the file. We may then try if it be attracted by the magnet, always using a minute fragment for this purpose. The action of muriatic acid should next be resorted to, to ascertain if the mineral effervesces; and it is right to mention, that the effervescence of some of the carbonates will scarcely be visible unless the mineral has been reduced to powder by scratching with a knife, or pulverizing it in an agate mortar, and at the same time we may determine whether it be partly or entirely soluble in the acid. The specific gravity should in every case be taken, if convenient, but in the present stage of our proceeding it is not absolutely necessary.

VIII.—Reagents used with the Blowpipe.

1. *Borax Flux.**—The borax of commerce sometimes contains impurities: it should be dissolved, and crystallized again, before it is used for experiments with the Blowpipe. It is kept in the state of powder, and is used to effect the solution or fusion of a great number of substances, and on the whole I consider it the most generally useful of all the fluxes.

I have found the following the most convenient mode of using this flux:—A piece of fine platina-wire, about the thickness of strong sewing silk—it should be fine, provided it be thick enough not to bend with the blast; if too thick, it absorbs too much heat—and about three inches in length, is fixed by one end in a piece of glass-rod, which is easily accomplished by fusing the end of the glass, and inserting the end of the wire, which must also be heated; the other extremity of the wire is bent into a hook, about the one-eighth of an inch in diameter. Having moistened the hook with the tongue, it is to be dipped into the powdered borax; portion which adheres is to be heated with the Blowpipe; at first

* The term *flux* is applied to those substances which, when added to mineral bodies, assist their fusion upon exposure to the action of fire; and when we have observed the effect of the heat on the mineral alone, it is then necessary to examine what further change takes place when it is subjected to other trials with the fluxes.

it swells up, owing to the water of crystallization which it contains, and afterwards fuses into a transparent globule, which adheres to the curved wire; it should then be allowed to cool, to ascertain if it is perfectly colourless; for should it be otherwise, some impurity is present. The globule should never be more than about the eighth of an inch in diameter; for if it is made too large, its weight while in a state of fusion will overcome its attraction to the wire, and cause it to fall off.

Having the assay prepared of a small size, and placed on the anvil, the next step is to fuse the borax again, and, while it is hot, apply it to the assay, which will adhere to it. At this moment, if the assay contain any water or volatile matter, it will be deposited on the cold iron, and if the quantity of water in the mineral is considerable, the vapour will be condensed in a number of very minute drops; in other cases, the surface of the iron will be only dull for a moment, if no water exists in the specimen. The surface of the anvil should be blackened by oxidation, to exhibit clearly this very delicate test of the presence of water, which, as far as we know, has not been practised by any one else; it is far more convenient than the use of the glass matrass recommended by Berzelius and others, and no time is lost in applying it.

The action of this flux furnishes us with many important characters. The assay may emit a few bubbles of different sizes at first, which in most instances is owing to the portion of water which remains; or it may effervesce briskly, with intumescence, as carbonate of lime; some of the earthy minerals emit a stream of uniform minute bubbles for an instant; while a few, as Scapolite, emit them in a continued shower until the assay is entirely dissolved. Some minerals become transparent, others become opaque, while a few change colour. Solution or fusion of the assay takes place quickly or slowly, wholly or partially, quietly or with effervescence.

But the most important of the characters afforded by this flux is the colour imparted to the glass, by which the presence of several metals is indicated. Chrome gives a rich green—iron, a dark olive-green colour with the glass: if the proportion of iron be very small, the colour is evident only while the glass is warm, a circumstance which, independent of the difference between the green caused by chrome and iron, is of some value in distinguishing them; for chrome becomes more clear when cold. Cobalt affords a very deep blue. We should also observe if the colour be different with the oxidating flame, from what it is with the reducing. Lastly, we observe if the colour increase or diminish by cooling; and if, at the same time, the glass preserve or lose its transparency.

Flaming.—Certain bodies have the property of forming a clear glass with borax, which preserves its transparency after cooling, but when slightly heated by the exterior flame of the candle, becomes opaque, and turns milk-white (Phosphate of Lime), or is coloured, particularly if the flame has been directed on the glass in an unequal and intermitting manner, as Glucina, Titanium. One condition, however, is necessary—that to a certain point the glass must be saturated with the assay; and the presence of silica also prevents the phenomenon, except when a very

large proportion of the assay is dissolved in the borax. This propertd has been termed *flaming* by Berzelius.

2. *Salt of Phosphorus Flux*, or, as it is commonly called, microcosmic salt, is a double salt, or a compound of phosphate of soda and ammonia. It should be pure, which is known by the glass which it forms remaining transparent when cold.

One inconvenience attends the use of this flux; it intumesces to a great degree when heated. I have been in the habit of fusing the salt, allowing it to cool, and then reduced it to coarse powder: in this state it intumesces much less, owing to the ammonia driven off; and a biphosphate of soda remains, which is deliquescent, but if kept in wide-mouthed bottles closely stoppered, little inconvenience results from this. It is more particularly applicable to the examination of the metallic oxides, whose characteristic colours it developes much better than borax. It is also useful in detecting silver in earthy compounds, which it sets free, in the form of a gelatinous mass, in the globule.

3. *Saltpetre, or Nitrate of Potash.*—Should be kept in the state of crystal: it is used as an oxidating agent, and is a very delicate test of the presence of manganese, when it exists in a proportion too minute to colour the glass of borax without it. The following is the method I adopt:—Having fused a small portion of the assay with borax on platina-wire, the globule while warm is to be brought in contact with a small piece of nitre, which decrepitates at first, but a sufficient quantity adheres. It is again submitted to the flame, and heated till intumescence takes place; and before the intumescence ceases it must be withdrawn, and allowed to cool, when an amethyst colour will appear, of more or less intensity according to the proportion of the manganese, and this colour may be destroyed in the reducing flame. By this means I have detected the presence of manganese in minerals which escaped the attention of skilful chemists, as in Cyprine, and in a variety of white Aragonite from Devonshire.

4. *Nitrate of Cobalt.*—Nitrate of cobalt, dissolved in distilled water, is employed to detect the presence of alumina and magnesia. The solution should be rather concentrated, and entirely free from alkali.

Alumina test.—The best mode in general of applying this test for alumin is to roast the assay in the outer flame until it becomes white, which in many instances renders it more absorbent; it is then moistened with a drop of the solution, and heated *strongly*, but *not fused:* after being heated for some time, the assay becomes blue, more or less pure, if it contain alumina. Wavellite exhibits this effect in a very striking manner. The blue colour of alumina is permanent in fusion, but it thereby loses its distinguishing character; for minerals which contain lime or alkali, without alumina, also become *blue* by fusion with oxide of cobalt, *but not till they have been fused.* The presence of a metallic oxide in the assay entirely destroys the action of this test, and hence its use is very limited, owing to the frequency with which iron is met with in earthy minerals. Silica does not prevent the appearance of the blue colour.

For the application of this test to the harder minerals, a different process is required. The stone is to be ground with a little water in an

agate mortar till reduced to a state of pulp, a drop of which is to be laid on charcoal, which will absorb the water, whilst the fine powder will remain on the surface. To this we add a drop of the solution of cobalt, and heat it to the brightest incandescence, at which moment the characteristic action is developed, and becomes evident when the assay is cold. If we perceive the mass to detach itself from the charcoal in the form of a scale, we may take it up carefully with the platina forceps, and expose it more easily to the degree of heat required.

Magnesia test.—The process for detecting magnesia is similar to that already described, but in this case we must endeavour to fuse the assay; for the magnesia compound acquires a pale rose-red tint, which is generally stronger after fusion; its use, however, for this purpose is very limited, as there are few compounds of magnesia which do not contain either alumina or iron. The sub-hydrate is the best substance for exhibiting the action of the test.

IX.—Cupellation.

The process termed cupellation is only resorted to for the purpose of ascertaining the presence of gold or silver when alloyed with other metals, and is effected in the following manner:—A piece of bone which has been exposed to the heat of a fire until all the animal matter has been consumed, which is known by the bone becoming white, is reduced to a very fine powder, a small quantity of which is to be taken on the point of a knife, moistened with the tongue, and kneaded in the left hand into a thick paste; a little soda may be added to give it cohesion, but it is not necessary. A hole is then made in a piece of charcoal, and filled with the paste, and its surface smoothed or slightly indented in the centre. It is then to be gently heated by the Blowpipe till it is perfectly dry. It is now ready for the assay, which must be previously fused with lead,* and then placed in the middle of the little cupel, and the whole heated by the exterior flame, for the purpose of oxidating the lead, which is absorbed together with the other impurities by the cupel. When the operation is finished, the precious metals are left on the surface; but the proportion of it being generally very small, owing to the size of the entire mass of the alloy often not exceeding a large shot, it is very generally necessary to have recourse to the magnifying glass to be certain of the presence or absence of the fine metal. When the grains are very minute, the colour of the metals will become evident by rubbing them in an agate mortar; and if any doubt exists, the application of a drop of nitric acid will speedily show the difference by its action on the silver, while it produces no effect on gold.

* When we wish to know if silver exists in an ore of lead, it is unnecessary to add any metallic lead to the assay.

XXXII.—On the Time of High Water in Dublin Bay on Good Friday, the 23rd April, 1014, the Day of the Battle of Clontarf. By the Rev. Samuel Haughton, M. A., F. R. S.,

[Read before the Royal Irish Academy, May 13, 1861.]

Some time ago I was asked by the Rev. Dr. Todd to calculate for him the time of occurrence of high water, on the 23rd April, 1014, the day of the battle of Clontarf; as he believed that such calculation would throw important light on the accounts that exist of that famous battle.

The following is a brief account of the calculation and of its result, which confirms in a remarkable manner the ancient account of the battle, with which I was unacquainted previous to making known to Dr. Todd the solution I had arrived at. I believe that, in consequence of the exact information obtained by the Academy in 1851 respecting the Irish tides, I am able to guarantee the result of my calculation of the time of high water, within a few minutes:—

From twelve o'clock, noon, of the 23rd April, 1014, to noon of the 12th December, 1860, allowing for the change of style and leap years, there were 309,223 real days.

The synodical period of the moon is 29.530588715 days, and new moon occurred on the 12th December, 1860, at 47.6 minutes after noon. Multiplying the length of the synodical month by 10472 months, we find

$$29{\cdot}530588715 \times 10472 = 309244{\cdot}325 \text{ days.}$$

From which, subtracting the number of days from 23rd April, 1014, to 12th December, 1860, or 309223 days, we find

$$21{\cdot}325 \text{ days, or } 21^d\ 7^h\ 48^m$$

It follows from this calculation that new moon occurred at

$$\begin{array}{llll} \text{April}, \ldots & 23^d & 0^h\ 47.6^m & \text{—1014, A. D.} \\ \text{Minus} \ldots & 21^d & 7^h\ 48^m & \\ \hline \text{Or, at} \ldots & 1^d & 16^h\ 59{\cdot}6^m & \text{—April, 1014, A. D.} \end{array}$$

i. e., at 5 o'clock on the morning of the second of April.

Therefore full moon occurred at

$$\begin{array}{llll} \text{April}, \ldots & 1^d & 16^h & 59{\cdot}6^m \\ \text{Plus} \ldots & 14 & 18 & 21{\cdot}6 \\ \hline & 16^d & 11^h & 21{\cdot}2^m \end{array}$$

Therefore the astronomical, or true full moon, occurred at 21 minutes past eleven at night of the 16th April, 1014.

Calculating by the established rules, the calendar or ecclesiastical full moon occurred on the 18th April, 1014 (Sunday), which would therefore make Easter Day fall on the 25th April, and make the 23rd April Good Friday, agreeable to the traditions of the battle of Clontarf.

I shall now show that the calculation of the tides makes it quite certain that the date 1014 falls in with all the physical circumstances related of the battle.

It appears from the calculation that I have given already that

The age of the moon at noon on the 23rd April, 1014, was 21.292 days, or $21^d\ 7^h$ nearly.

The tide was therefore a neap tide, and the moon in her third quarter.

From the Academy's observations, it appears that on such a day of the moon's age, at the spring equinox, the tide at Kingstown is full at

$5^h\ 22^m$ in the morning,

from which it follows that the tide along the Clontarf shore, when not obstructed by embankments and walls, could not have differed many minutes on the 23rd April, 1014, from

$5^h\ 30^m$ A. M.;

the evening tide being full in at

$5^h\ 55^m$ P. M.

In the following narrative, the full tide in the morning is said to have coincided with the sunrise: and as the sun rises from $5^h\ 30^m$ to $4^h\ 30^m$ in the month of April, the truthfulness of the narrative becomes strikingly evident. The extract is taken from the "Wars of the Gaedhil with the Gaill;" or, "The Wars of the Irish with the Danes and other Foreigners," a work which Dr. Todd is editing in the original Irish, with a translation and notes, and which will form one of the series of Historical Chronicles of Great Britain and Ireland, now in course of publication under the authority of the Government. The following narrative occurs in ch. cvii. of this work:—

CVII.—"However, now, they continued in battle array and fighting from sunrise to evening. This is the same length of time as that which the tide takes to come, and to flood and to ebb. For it was at the full tide the foreigners came out to fight the battle in the morning, and the tide had come to the same place again at the close of the day, when the foreigners were defeated; and the tide had carried away their ships from them, so that they had not at the last any place to fly to, but into the sea, after all the mail-coated foreigners had been killed by the Dal Cais. An awful rout was now made of the foreigners and of the Laighin (Leinstermen), closely and simultaneously, and they shouted their respective cries, and whoops of rout, and retreat, and running; but they could only fly to the sea, because they had no other place to retreat to, seeing they were cut off between it and the head of Dubhghall's Bridge; and they were cut off between it and the wood on the other side. They retreated therefore to the sea, like a herd of cows in heat, from sun, and from gadflies, and from insects; and they were pursued closely, rapidly, and lightly; and the foreigners were drowned in great numbers in the sea, and they lay in heaps and in hundreds, confounded, after parting with their bodily senses and understanding, under the powerful, stout, stern mauling, and under the

tremendous, hard-hearted pressure with which the Dal Cais, and the Connachtmen, and as many as were also there of the nobles of Erinn, pursued them."

I shall leave to Dr. Todd and others, well informed of the circumstances and localities of the battle of Clontarf, to draw further conclusions from the calculation I have presented to the Academy. To my mind it appears to throw considerable light on the foregoing narrative, and to establish conclusively that portions of it, at least, must have been written from the testimony of actual eye-witnesses, as none others could have invented the fact that the battle began at sunrise, and that the tide was then full in. The importance of the time of tide became evident at the close of the battle, at 6 P.M., when the returned tide prevented the escape of the Danes from the Clontarf shore to the north bank of the Liffey.

XXXIV.—On the True Height of the Tide at Ireland's Eye on the Evening of the 6th September, 1852, the Day of the Murder of Mrs. Kirwan. By the Rev. Samuel Haughton, M. A., F. R. S.,

[Read before the Royal Irish Academy, May 27, 1861.]

The following facts relative to the tide at Ireland's Eye were ascertained by me in December, 1852, in consequence of the reports of Mr. Kirwan's trial, published in the Dublin newspapers, containing statements as to the time and height of the tide on the evening of the 6th September, which carried with them internal evidence of their inaccuracy. For example, it was given in evidence that the hour of high water on the evening of that day was half-past three o'clock, and that the range of the tide was nine feet. I knew, from the tidal observations of the Academy, of which I had the custody, that both these statements were erroneous; and, as they both seemed to be considered of importance in the trial, I resolved to make the measurements requisite to ascertain the truth with precision. I have never yet made the results I arrived at public, as they did not affect the result of the trial, for a reason which will be stated; and I now bring them before the Academy as an illustration of the importance of the tidal observations made by that body, and to show the valuable uses to which those observations may be applied. In bringing forward this subject, I have no wish to accuse those who conducted the prosecution of any negligence in procuring the best scientific information available, nor to express any opinion as to the course adopted by the Lord Lieutenant, in commuting Mr. Kirwan's sentence, after his conviction for the murder of his wife.

On the 18th December, 1852, low water occurred exactly at 10 A. M. (Dublin time), at Ireland's Eye; and on the same morning, by simultaneous observations on the tide-gauge at Kingstown, it was found to occur there at $9^h\ 53^m$, showing that the tide at Ireland's Eye is seven minutes later than that at Kingstown. By careful levellings made forwards and backwards by Professor Downing, it was found that the top of the "Body

Rock" was 1·26 feet higher than the zero of the tide-pole used on the 18th December. The following table contains the quarter-hour observations made on this occasion at Ireland's Eye and Kingstown:—

Hour.	Height of Tide at Ireland's Eye.	Height of Tide at Kingstown.	Difference.
9·0 A. M.	0·60 ft.	6·25 ft.	5·65 ft.
9·15 "	0·43 "	6·00 "	5·57 "
9·30 "	0·21 "	5·82 "	5·61 "
9·45 "	0·20 "	5·85 "	5·65 "
10·0 "	0·20 "	5·75 "	5·55 "
10·15 "	0·18 "	5·80 "	5·62 "
10·30 "	0·21 "	5·85 "	5·64 "
10·45 "	0·44 "	5·95 "	5·51 "
11·0 "	0·56 "	6·20 "	5·64 "
			5·60 ft.

The interval from high water at Kingstown to that at Ireland's Eye being thus found to be seven minutes, and the zero of the tide-gauge at Kingstown being ascertained to be 5·604 feet below the zero of the tide-pole at Ireland's Eye, we have, since the top of the "Body Rock" is 1·26 feet above the zero of the tide-pole, the following result:—

	Feet.
Height of zero of the tide-pole above zero of gauge, .	5·604
Height of "Body Rock" above zero of pole, . . .	1·260
Height of "Body Rock" above the zero of the Kingstown tide-gauge, ...	6·864

On the day of Mrs. Kirwan's death, 6th September, 1852, the moon's age at noon was $21^d.9$ and her declination 20° 1′ 54″ N. The tide of the evening of this day is, therefore, comparable with that of the morning of the 18th September, 1851, when the moon's age at midnight preceding was $22^d.1$, and her declination 19° 51′ 14″·8 N.

Calculating the times of high water, low water, and half ebb, from the Academy's observations at Kingstown for the 18th September, 1851, I find that on the evening of the 6th September, 1852,

High water at Ireland's Eye occurred at	$4^h\ 37^m$	P. M.
Low water, ...	10·14	"
Half ebb, ...	7·25	"

and that the range of the tide on that day was only 6·7 ft., the moon being in the commencement of her fourth quarter; and, therefore, the tide being neap. Introducing into the tidal observations at Kingstown the difference between the top of the "Body Rock" and the zero of the gauge, or 6·864 ft.,—I find the following Table to give the true heights of the Tide at Ireland's Eye on the 6th September, 1852, referred to the "Body Rock" as the zero; and I have placed beside the true heights the heights alleged in Court during the trial of Mr. Kirwan.

Heights of Water above Top of "Body Rock," 6th September, 1852.

Time.	True Height.	Height alleged in Court.	Difference.
High Water,	+ 4·84 ft.	+ 7·00 ft.	+ 26·0 in.
6·30 P. M.	+ 3·11 „	+ 2·50 „	− 7·3 „
7·0 „	+ 2·37 „	+ 1·75 „	− 7·4 „
7·15 „	+ 1·85 „	+ 1·375 „	− 5·7 „
7·30 „	+ 1·34 „	+ 1·00 „	− 4·0 „
Low Water,	− 1·86 „	− 2·00 „	− 1·7 „

Fortunately for the interests of justice, the time of Mrs. Kirwan's death coincided very nearly with the time of half ebb of the tide, 7^h 25^m, P. M., when the real height of the water above the "Body Rock" only exceeded that alleged on the trial by 5 inches. Had the critical moment been near the time of high water, the evidence given would have been in error by upwards of 2 feet; and as the exact height of the water was considered of great importance by both the Crown and the prisoner's counsel, a substantial injustice would have been done to one side or the other by the admission of erroneous evidence on a scientific question of so great delicacy and importance.

XXXV.—On the Amplitude of the Daily Variation of the Magnetic Dip in Christiania between 10 A. M., and an Hour before Sunset, from 1844 to 1859. By Professor Hansteen, of Christiania.

[Read before the Royal Irish Academy, May 27, 1861.]

"In the following Table *n* is the number of days in each month upon which the dip has been observed at its maximum in the morning, and at its minimum in the afternoon. *Variation* is the difference between *inclinatio antemeridiana* and *postmeridiana*, which has, without exception, been always positive.

Month.	*n*	Variation.
January, ...	18	+ 0′·382
February,. . . .	17	+ 0 ·329
March,.	25	+ 0 ·974
April, ...	35	+ 2 ·365
May, ...	48	+ 3 ·155
June, ...	59	+ 3 ·231
July, ...	30	+ 2 ·787
August, ...	37	+ 1 ·766
September, . . .	36	+ 1 ·831
October, ...	18	+ 1 ·227
November, . . .	18	+ 0 ·928
December, . . .	15	+ 0 ·239

"The observation of the true magnetic dip does not depend upon any difficulty in *reading* the position of the needle when it is in equilibrium; but only upon the question, if when the horizontal axis has been elevated from the agates, it *always returns* to the *same points of division*. With large needles, like those of Gambey, with good lenses opposite both ends of the needle, when the axis has been elevated from the agates, and the needle makes oscillations of 30, 40, or 50 minutes, I observe three consecutive extremes,—a minimum α, a maximum β, and a minimum γ. Each of these can be observed correctly to a minute. The true position in equilibrio is then $\frac{1}{2}\left[\frac{\alpha+\gamma}{2}+\beta\right]$. In the oscillation of the needle, and its mechanical moment, every obstacle, such as a little friction and small irregularities in the pivots of the axis, is overcome. Observing the same three extremes at the other end of the needle before a new elevation of the axis, I then take the mean of these two means. In the same position of the needle, I repeated this formerly four times; so that in the eight different positions of the needle and limb I had thirty-two readings of each end of the needle. As I found by long experience that the four means, in every position, differed very little from each other, I have in the latter two years diminished them to three.

"With your little circle, with microscopes, it is necessary to *wait* till the needle is *quiet*, and to direct the wire to the upper point of the needle, and read both verniers, then to the lower point, and read again. But when the needle makes only an angle of 3, 4, or 5 minutes with the true position of equilibrium, its moment is so weak, that the least effect of friction, and irregularity in the pivots, can stop it in a false position. I therefore regard the microscopes as unnecessary, and even injurious. It is true that a correct dip depends also upon the skill and experience of the observer; and I confess that for a dilettante, who makes an observation for the first time, the microscope may be agreeable, as it gives an imaginary correctness.

"The above-cited facts of the daily variation, observed with Gambey's instrument, without microscopes, are a clear proof of this. I have not seen that any observer with the small Barrow has detected the daily variation, and its gradual increase from the winter to the summer solstice.

"From April, 1859, there has arisen a period of great perturbations, with flashings of polar light (Aurora Borealis), and great spots in the sun. The daily variation is still always positive, but extraordinarily great: it has once amounted to 1° 2′; and the variations of the Bifilar have been great in proportion. As the latter instrument is always observed by an assistant twice in the same hour with my observations of the dip, I will give some examples:—

1859.	Daily Variation.		
	Dip.	Bifilar.	
April 21, . . .	+ 27′·47	− 485·0	Aur. Bor. evening.
„ 22, . . .	+ 7·04	− 131·7	Ditto.
June 8, . . .	+ 17·02	− 295·9	Aur. Bor. could not be seen for the crepusculum.
July 11, . . .	+ 16·66	− 268·5	
„ 19, . . .	+ 12·33	− 181·7	
August 22, . .	+ 7·51	− 133·9	21, Vehement Aur. Bor. evening;
„ 29, . .	+ 11·76	− 179·1	28, and midnight.
September 2, .	+ 32·03	− 301·3	
October 18, . .	+ 19·69	− 355·7	Aur. Bor. 17, 18, 20, evening.
„ 21, . .	+ 16·21	− 259·1	
1860.			
February 21, .	+ 4·08	− 168·2	Aur. Bor. evening.
May 24, . . .	+ 8·97	− 180·8	

"Every time that I saw in the evening observation, in my tent, an extraordinarily *small dip*, I was sure that the Bifilar marked a *strong horizontal intensity*, which never failed. The Bifilar variation above given is the difference of parts of the scale (forenoon − afternoon). For instance:—

		Dip.	Bifilar.
September 2, .	$10^h\ 23^m$ A. M.,	71° 29′·01	687·56
„ .	$4^h\ 16^m$ P. M.,	70 26·98	1488·91
	Difference, . .	+ 1 2·03	− 801·35

"One part of the scale of the Bifilar = $\frac{1}{13970}$ of the horizontal intensity.

"HANSTEEN."

Dr. Lloyd communicated also to the Academy the following extract from a letter from Professor Hansteen, dated April 17, 1861:—

"At our interview in Christiania, in July, 1860, I communicated to you the mean *daily variation* of the magnetic dip in this place between its maximum at 10 A. M., and its minimum, about half an hour before sunset, for every month in the year, deduced from different years between 1844 and 1859. This variation, which at the winter solstice was only a fraction of a minute, increased very regularly to a little more than three minutes towards the summer solstice, and decreased again as gradually towards December.

"In order to ascertain if there is a *monthly variation* of the dip in the course of the year, I began, from April, 1855, to observe the dip in its daily maximum and minimum, generally five or six days about the middle of each month, to this year. The mean of the daily maximum and minimum, is contained in the following Table:—

	1855.	1856.	1857.	1858.	1859.	1860.	1861.	Means. 1856—1860.
January, . .	......	71° 25'·858	71° 23'·886	71° 25'·114	71° 22'·754	71° 21'·561	71° 20'·188	71° 23'·785
February, . .	......	26 ·544	24 ·283	24 ·110	22 ·824	20 ·645	21 ·880	23 ·671
March, . . .	......	25 ·558	24 ·164	24 ·478	22 ·727	23 ·657	21 ·891	24 ·117
April, . . .	71° 27'·985	24 ·622	23 ·771	24 ·057	20 ·095	21 ·828	19 ·582	22 ·875
May, ...	26 ·050	23 ·885	23 ·942	23 ·205	20 ·072	20 ·881	......	22 ·277
June, . . .	26 ·082	23 ·685	22 ·794	22 ·585	20 ·201	20 ·678	......	21 ·978
July, ...	.. ..	23 ·724	23 ·183	22 ·158	20 ·866	20 ·788	......	22 ·188
August, . .	25 ·820	23 ·640	23 ·806	21 ·506	22 ·220	20 ·785	......	22 ·291
September, .	27 ·225	24 ·660	25 ·612	22 ·998	23 ·427	21 ·868	......	23 ·718
October, . .	26 ·796	25 ·887	24 ·774	23 ·784	23 ·068	21 ·789	......	23 ·740
November,	26 ·870	24 ·047	24 ·849	22 ·701	22 ·918	21 ·618	......	23 ·224
December, . .	25 ·285	24 ·078	23 ·458	23 ·840	21 ·688	21 ·248	......	22 ·751
Mean, . .	71° 26'·488	71° 24 ·268	71° 23'·994	71° 23'·886	71° 21'·817	71° 21'·894		

"From the last column in the foregoing Table, it is clear that there is a maximum at the Equinoxes, in March and at the end of September, and a minimum at the Solstices, in June and December. The greatest variation is between March and June, and is equal to 2'·139. The mean yearly decrease between 1856 and 1860 = 0'·718; but between the incomplete year 1855, and 1860, it is 1'·008.

"Three days after your departure from Christiania, I was going in a steamer along the coast to Trondhjem, sent by the University to represent it, as its senior member, at the coronation of the king and queen. I made observations of the magnetical intensity and dip in Bergen and in Trondhjem on different days. I shall only communicate the latter, with former observations by different observers.

TRONDHJEM.

Inclination = i; Horizontal Intensity = H.

t.	Observer.	i.	Formula.	Δ.	t.	Observer.	H.	Formula.	Δ.
1823·70	Sabine,	74° 43'·05	74° 44'·80	− 1'·75	1825·5	Hansteen,	1·3425	1·3423	+ 2
1825·50	Hansteen,	− 40'·70	− 37'·65	+ 3'·05	1832·59	Hansteen,	1·3579	1·3586	− 7
1832·57	Hansteen,	− 10'·75	− 12'·97	− 2'·22	1838·47	Boeck,	1·3707	1·3702	+ 5
1838·51	Meyer,	73° 57'·31	73° 56'·18	+ 1'·13	1860·59	Hansteen,	1·3992	1·3992	0
1860·61	Hansteen,	− 25'·50	− 25'·65	− 0'·15					

$$i = 74^\circ\ 21'{\cdot}362 - 3'{\cdot}4005\ (t - 1830) + 0'{\cdot}051509\ (t - 1830)^2.$$
$$H = 1{\cdot}3410 + 24{\cdot}925\ (t - 1825{\cdot}0) - 0{\cdot}24116\ (t - 1825{\cdot}0)^2.$$

These formulæ give the following values for the yearly decrease of dip and intensity:—

t.	Δ i.	Δ H.
1825	− 3'·915	+ 24·9
1830	− 3 ·400	+ 22·5
1835	− 2 ·885	+ 20·1
1840	− 2 ·370	+ 17·7
1845	− 1 ·855	+ 15·3
1850	− 1 ·340	+ 12·9
1855	− 0 ·825	+ 10·5
1860	− 0 ·310	+ 8·0

"The minimum of dip = 73° 25'·38, and corresponds to the epoch t = 1862·97. The maximum of intensity = 1·4054, corresponding to the year 1876–7. The total and vertical intensity can be calculated from the computed results, or from the observed quantities."

Dr. Lloyd observed that there could be no doubt of the excellence of the observations recorded in the foregoing communication: they afforded

abundant proof, both of the perfection of the instruments employed by Professor Hansteen, and of his skill in using them. But the fact that the diurnal variation of the inclination has not been observed with the English dip circles could not, he thought, be fairly adduced in proof of their inferiority to the French instruments; inasmuch as this element is obtained by us more completely by other instrumental means. By means of the balance magnetometer (combined with the bifilar magnetometer) not only the range, but the *whole course* of the diurnal variation of the inclination, has been completely determined at Dublin; and the same thing is true of other places at which both these instruments have been employed. In fact, it is in this circumstance that the advantage of the British observatories over those of the Continent mainly consists, the daily observations of the latter being limited to two of the three magnetic elements.

Dr. Lloyd believed that it was unnecessary for him to enter further into the question of the accuracy attainable by the dip circles of the form now used by English observers, as the subject would be fully discussed by Mr. Stoney in a paper to be read by him to the Academy that evening. He would merely observe that Professor Hansteen seemed to be under a misconception in supposing that it was necessary, with these instruments, to observe the needle *at rest*. By the help of a small divided scale in the focus of each of the microscopes, the wires may be either *placed* in the position of equilibrium, while the needle itself is in motion, or (the microscopes being fixed) the deviation of the wires from that position may be observed, and added, with its proper sign, to the readings of the verniers. This simple addition had, in fact been made in the original instrument of this construction, which was made by Mr. Barrow for Dr. Lloyd, and according to his specifications.

XXXVI.—On the Degree of Accordance which may be attained in Observations made with Dr. Lloyd's Dip Circles. By Mr. G. J. Stoney.

[Read before the Royal Irish Academy, May 27, 1861.]

In fixed magnetic observatories the instruments may be mounted with every appliance, however cumbersome, which contributes to accuracy; but when we mean to carry an instrument from station to station, making observations with it at each, the necessity that it be of moderate size, and not easily injured or thrown out of adjustment, debars us from many arrangements which we might otherwise make. Yet with such travelling instruments very considerable degrees of accordance have been attained, and, as I think, much more accuracy is within our reach, by attention to a small mechanical detail.

In the most sensitive of the travelling dip circles for use on shore, the needle rests by a thin and most carefully constructed transverse axis on two smooth horizontal pieces of agate, upon which the axis rolls without rubbing as the needle oscillates before coming to rest. A wonderful degree of delicate mechanical accuracy has been attained in the construction of this minute cylindrical axes, an accuracy which would

even have gone beyond the requirements of the instrument, had not Dr. Lloyd removed a source of magnetic derangement, by which all the earlier observations were disturbed.

This disturbance arose from the graduated circle of the instrument, which used formerly to be brought as close to the needle as possible. Dr. Lloyd was led, from an analysis of the observations he made in the magnetic survey of 1828, closely to test this circle; and he found that, though made of materials which were supposed to be non-magnetic, it exhibited a trace of magnetism which injuriously affected the needle. He accordingly removed the circle to a sufficient distance from the needle, and ascertained the position of the needle by two microscopes carried by an arm which traverses the circle, and thus at once got rid of the magnetic disturbance, introduced greater accuracy into the reading of the position of the needle, and secured other important advantages, into which we need not now enter.

This has again made the *mechanical* arrangements of the instrument the more defective; and I propose now to give some account of the degree of accordance which may be expected with the dip circle with which a magnetic survey of the southern half of Ireland was made in 1858, and of a slight modification of the apparatus for placing the axis of the needle on the agate planes, whieh would, I believe, render it possible to secure a higher degree of accordance.

In determining the magnetic dips at any station, the axis of the needle is placed in eight distinct positions upon the upper horizontal edges of parallel agate plates, on which it can roll freely, and the position of each end of the needle observed about three times in each of the eight positions.

Between each pair of readings the needle is lifted and replaced by a little frame, designed to lay the needle down with suitable precision on the edges of the agate plates. Each time that the magnet is replaced by this frame, it swings about for a short time, and the position it assumes when these oscillations are over is recorded.

The axis of the magnet is thick in the centre, where it passes through the magnet. The ends, where it is to rest on the agate plates, are most carefully turned down to a needle-like thinness; and on either side, between the thick and the thin parts, there are short pieces of intermediate thickness, which are to be placed in Ys, with which the lifting frame is fitted. The endlong adjustment of the axis is effected by the same Ys, since the thick part of the axis falls between them, resting against the sloped inner sides of the Ys by its cone-shaped ends. This little frame thus discharges distinct offices; it brings the proper parts of the axis of the needle down upon the agate plates, it places them upon the right parts of the edges of the agate plates, and it sets the magnet swinging between each pair of readings, since the frame turns on pivots at one end, and thus imparts a motion of rotation to the magnet in depositing it. When the glass case of the instrument is shut, the observer can raise and lower the magnet from without by this lifting frame.

This piece of apparatus needs to be manipulated with care. If the needle be lowered too rapidly, it comes down with a sensible impact

against the hard agate plates, and hops upon them, thus altogether deranging the adjustments which the frame was designed to secure. If, on the other hand, it be lowered too slowly, there are two sources of mischief. The two ends of the axis do not reach the agates at strictly the same instant; and in the intervening moment one end of the axis is still resting in its Y, while the other is rolling on the agate plate, and disturbing the adjustment. But the chief source of error seems to arise from the axis receiving a slight brush from the Ys in parting from them. This arises in a variety of ways, and can be reduced to its minimum only after some practice. There are some positions of the needle in which, upon some days, the effects of this friction can, by careful manipulation, be reduced to an insensible amount;* but there are other positions of the needle in which I found it impracticable, by any care or patience, to evade it; and the slight alteration of the proportions of the parts, due to the differences of temperature from one day to another, is enough to make it sometimes very troublesome in almost all positions of the needle. These remarks will help to show that which I am anxious to insist on, that this part of the instrument deserves all the care the maker can bestow on it.

As an illustration, I will transcribe two complete observations taken at the same station on consecutive days,—the first of which happened to be more than usually free from this source of error, and in the second of which it was particularly troublesome.

Parsonstown (Lord Rosse's Demesne); August 24, 1858; *from* 2¾ *to* 3½ *P.M.*

Poles Direct. A. North End.		Poles Reversed. B. North End.	
E. Limb.	W.	W. Limb.	E.
70° 24′	109° 60′	109° 44′	70° 4′
23	59	44	5
24	60	44	5
31	60	51	18
30	60	51	18
30	60	52	17
69° 43′	109° 32′	109° 58′	70° 16′
43	32	59	15
43	31	59	14
53	36	59	21
53	36	59	20
53	35	58	20

Mean of Means or Dip = 70° - 10′·44.
Dip corrected for daily range, 70 - 11 · 4.

* I. e. insensible in an instrument reading only to minutes.

Same Station, August 25, 1858; *from* 9ʰ 40ᵐ *A. M.*, *to* 10¼.

Poles Direct. B. North End.		Poles Reversed. A. North End.	
E. Limb.	W.	W. Limb.	E.
70° 6′	109° 43′	109° 57′	70° 28′
6	44	57	30
8	43	58	30
17	48	56	33
18	49	57	36
19	49	57	36
70° 20′	109° 59′	109° 27′	69° 40′
18	58	28	40
20	58	25	40
23	57	31	51
21	57	31	51
24	57	29	52
Mean of Means or Dip = 70° 12′·75			
Dip corrected for daily range, 70 10′· 4			

In the sixteen sets of readings which make up the observation of the 24th August, that least embarrassed by the injurious action of the Ys, there is but one case in which this discordance amounts to 2′, while there are four cases of complete accordance. In the eleven others, a difference of one minute of arc occurred. On the other hand, in the observation of the 25th August, but two cases of complete accordance will be found, while the difference three times rises to 3′, and in five other cases it is 2′.

The injurious effect of the hitching produced by the Ys is equally apparent, if, instead of scrutinizing the individual observations, we combine parts of different observations, so as to bring out numbers which ought to be identical in sets. I have done this in various ways with the series of observations made in the survey of the southern half of Ireland in 1858, and found in several instances, instead of identical numbers, differences of one or two minutes, and occasionally, though rarely, of three minutes. These differences are doubtless in part due to magnetical causes; but they clearly point to a mechanical origin also, since they lean in a marked manner towards those positions of the needle in which the hitching of the Ys was most troublesome.

If anything else be necessary to show how much dip observations are effected by a careless design or construction of the lifting apparatus, it will be found in the astonishing, and to me quite unexpected, accuracy with which the needle will roll back to its position when in any fair

way displaced from it. This was tested by fastening a small plane mirror to the side of the needle with white lead, and counterpoising it with a little lump of bees' wax, so that when the needle was placed on its agate plates, the reflected image of one of Gauss's scales could be observed by a telescope. The scale was so placed that a millimetre on it corresponded to a minute of arc, and thus 10ths of a minute could be easily read by estimation. These dispositions were made in the small observatory of Trinity College for absolute determinations, in which tremors were wholly avoided, and it was possible to keep the instrument undisturbed for several days. From the observations made there, it appeared that, with a needle rolling on plates of agate, we can follow the daily range with great precision, and observe occasional disturbances, of which many were seen from one to six or eight tenths of a minute; and that when the needle is artificially swung by the attraction of a key through ranges varying from three minutes to four degrees, it returns to its position certainly within the tenth of a minute, and probably within a very small fraction of the tenth of a minute.

Hence it is plain, that if we can bring the apparatus for laying down and removing the needle to a state of mechanical perfection corresponding with that of the axis, we shall be able to use dip needles rolling on agate plates for many purposes for which they have hitherto been supposed not capable of affording determinations of the required degree of accuracy, but for which they are otherwise eminently suited.

It appears essential that the endlong adjustment should be given to the axis by a part of the apparatus distinct from the Ys. Perhaps it could be successfully made by a little edge of agate mounted so as to rise into a carefully turned V-shaped groove in the thick part of the axis. It also appears to me that the Ys should be brought to bear on the carefully turned cylindrical ends of the axis, and mounted so that they could be easily adjusted to let down the two ends of the axis strictly at the same moment; and that each Y should be formed of two plates of agate, worked to a rounded edge, and placed at an angle as obtuse as is consistent with insuring that the axis drop always to the bottom of the Y. This would very much assist the Ys to disengage themselves completely and abruptly from the axis as soon as it comes in contact with the edges on which it is to roll. I should also prefer that the frame carrying the Ys should rise vertically, and not turn on a pivot, which communicates mechanically, and always in the same direction, a rotation to the magnet in placing it on the agate plates. A swing, to be communicated afterwards by magnetic influence from without, would seem to be much better. Of course, attention should be given to the parts by which this vertical motion is to be given, to make it smooth and without shake.

With attention to these details, some of which I have tested with very promising results, it seems likely that a dip circle might be made which should allow the needle to be removed from the instrument, and replaced, without risk of any error exceeding a few seconds.

XXXVII.—On the Affinities of the groups Trematoda, Planariæ, and Hirudinei; and on the formation of a new Class of Annuloida for the reception of these Animals. By Henry Lawson, M. D.

[Read before the Royal Dublin Society, on Monday, May 20, 1861.]

Before entering into the details of the relation which exists between the groups Trematoda, Suctoria, and Planariæ, it is necessary that a retrospective glance be given at the various positions which the beings comprised by these groups have held since the time when zoology became an exact science; and on doing so, we observe that Trematoda and Suctoria have remained almost in the same classes in which they were originally located; whilst the Planariæ have constituted a sort of zoological shuttlecock, tossed about from class to class, and from order to order, at times forming an isolated division, and even in latter years excluded from the animal type in which they remained for so long a period, and ranked among the Cephalophorous Molluscs as Gasteropods. In reviewing the taxology of these departments, it is hardly necessary to revert to the position assigned to them by Linnæus, who included all three, with every other non-articulate invertebrate in his sixth class Vermes. Cuvier, who seems constantly to have conceived happily the affinities of animals, united the Flukes and Planarians under his division Intestinaux, which, however, formed the second portion of his very heterogeneous type Zoophyta, the Leeches being grouped with the other representatives of the Annelida, a class which he established in 1802.

We find an advance in the formation of the class Entozoa, by Rudolphi, among the families of which were ranked the Trematoda, the Planaria, however, finding no place there. *Ehrenberg* separated the latter from the Intestinaux of Cuvier; and, observing that the surface of their body was clothed with cilia, joined to them the Nemertidæ, which are also ciliated (though without the most remote affinity in any other particular), and the group thus formed, designated *Turbellaria*. *Audouin* and *Milne Edwards* adopted Cuvier's Annelida, dividing them into the four well-known orders Terricola, Tubicola, Suctoria, and Errantia; and the latter naturalist has given a modification of Ehrenberg's Turbellaria, in which he very incongruously brings together Nemertes with Planaria and Distoma. Many objections were raised against the class Turbellaria; and among those who pointed out its artificial nature was Oërsted, who seems to have considered the correct position of Planaria to have been with Hirudinei.

Siebold in part adopts the classification of Ehrenberg, but shifts the Nemertes to the Annelida, and retains the Planariæ distinct; he places the Trematoda in the class Helminthes, and the Leeches stand after the Nemertini among the Annelids. Van der Hœven recognizes the Turbellaria as a division, but forms them into an order of his class Annulata, a synonym of Annelida. Owen, in his lectures on the Invertebrata, has classed the Planariæ with the Trematoda, perceiving their natural affinities; whilst Dr. Carpenter, in the *last* edition of his "Manual of Zo-

ology," includes in the class Entozoa the whole of Ehrenberg's Turbellaria, placing them under a division, Platyelmia,—of which he gives the following characters:—"Body almost always flat, destitute of segments; intestinal canal with but one orifice; animals hermaphrodite"—not one of which characters are descriptive of or applicable to the family Nemertidæ. Finally, Huxley in his lectures on Natural History entirely admits the *class* Turbellaria of Ehrenberg.

Having given this brief outline of the literature of these classes, it becomes necessary to exhibit the imperfections of our present arrangement. It cannot for a moment be denied, that a system of classification based upon some artificial character, arbitrarily selected, tends in a great measure to impede the progress of zoology; that this state of things exists, and is exhibited in our modern text books, is equally true; whence the object of the present paper, in a manner to construct a natural group, from materials scattered through different, some of them exceedingly artificial, classes. What can be more unscientific than the formation of a division of animals whose only common character is their existence within the living substance of some other beings? Such a class should (were the characters rigidly adhered to) enclose within its extremes the heterogeneous and non-affined series Tænia, Æstrus, and Pulex; in other words, the present class Entozoa should be looked on as a relic of barbarism, more out of keeping with our present advanced position than that popular arrangement of the animal kingdom, which would embrace every living creature in its three classes,—beasts, birds, and fish. Modern philosophic naturalists have appreciated the necessity for dispensing with the old method of distributing the Entozoa; and, accordingly, we find Huxley arranging the following classes, in his lower division of the type Annulosa:—Annelida, Rotifera, Echinodermata, Scoleidæ, Trematoda, Tæniadæ, Turbellaria, Nematoida. Now, what I propose is, to remodel this system of Professor Huxley's in the following manner:—Let the Turbellaria be divided; place the Nemertini in juxtaposition with some of the Annelida; then, removing the Leeches from the latter, unite them with the Trematoda and Planariæ, and constitute a distinct class, to which the term Suctoria might be appropriately applied. Thus the number of Professor Huxley's classes is diminished by the removal of one, and the term Suctoria is substituted for that of Trematoda.

The separation of Planariæ from Nemertini is fully justified by the fact, that the only resemblance existing between the two families is that which is seen in the permanent provision of cilia in both. Planariæ have usually a dendritic alimentary system, without an anus, whilst Nemertes is provided with the latter, but devoid of stomachial cæca. Planariæ is also depressed, fluke-shaped, and inarticulate; but Nemertes is ringed to some extent, and elongate.

The absence of relation between Nemertes and Planaria being evident, I pass now to the consideration of the affinities of the three groups which form the subject of this paper. In examining these, it is necessary to select from each a species typical, or representative,

of the division to which it belongs. I have chosen the common Leech, the Liver-fluke, and Polycelis, as those most likely to exhibit the characters respectively of the embranchments which they represent; and in proceeding to deal with the question, How are they related to each other? it is necessary to investigate their affinities under different heads. In this manner I shall bring under your notice the various organic systems of the animals; firstly, the digestive; then, the reproductive; next, the circulatory and respiratory; and, afterwards, the nervous and locomotive. Finally, I shall advert to the mode of development, so far as our present acquaintance with the matter will permit. In dealing with the systems of organs thus, I shall describe that of each animal in succession, in order that, by this means, their mutual relational characters may be more perspicuously observed. Although I commence with the digestive apparatus, I do not intend it to be assumed that the greater weight is laid upon its peculiarities in determining the position of any group of animals; for there can be no doubt that development, when correctly determined, affords the securest clue to natural classification. My selection of the alimentary in preference to any other system is wholly arbitrary; yet I think its peculiarities are almost the first that would lead one to suppose an analogy between these beings. In Polycelis, which has been so carefully examined by De Quatrefages, the digestive organs are represented by a short œsophagus, which leads to a large elliptical cavity, the stomach, the surface of whose walls is inverted to form numerous branching tubes, which terminate in cæcal pouches, that project in every direction through the parenchyma of the body. There is no intestinal canal, and consequently no anal aperture. The mouth or orifice of the œsophagus, which is situate about the middle of the inferior surface of the body, is surrounded by a strong sphincter, which enables it to perform the function of a sucker. Distoma's alimentary parts are very similar; the mouth, which is more anterior, is surrounded by a sucker, and leads to a short œsophagus, terminating in a small pharynx or stomach, from which diverge two tubes, extremely dendritic, the final ramules being cæcal. These extend to the posterior extremity of the creature; but there is no anal aperture,—the orifice formerly so called being, in reality, the external opening of a peculiar gland.

The conformation of these parts in Hirudo is very analagous: the mouth, which is placed within the circumference of the anterior sucker, is continuous with the gullet, a short canal leading to the stomach. This organ, which is extremely capacious, and more or less divided by numerous constrictions, extends nearly the whole length of the body, and gives off from each of its sides nine or ten cæcal pouches, which stretch into the substance of the animal; two of these, which are longer than those more anterior, extend almost to the caudal extremity. This animal differs from the foregoing, in the possession of an intestine and anus; the former is a very delicate tube, commencing by an exceedingly minute aperture in the stomach, and terminating similarly behind in the anal orifice, which latter is so small as to be barely perceptible.

Before entering into the anatomy of the reproductive apparatus in the three animals, it may be remarked that all are hermaphrodite*, and have the intromittent organ anterior to the vaginal, mutual impregnation being the rule.

In Polycelis, the male organs appear to consist of two elongate and somewhat fusiform testicles, which are continuous anteriorly with the general tissue of the body. These terminate in a pair of short vasa deferentia, which pour the seminal contents into the comparatively enlarged vesicula seminalis, which, in its turn, conveys the element to a papillæform, erectile structure,—the penis. The ovaries present, on the whole, a decided resemblance to the testes, and terminate distally, in a similar manner; from their posterior margin arise a couple of small oviducts, which open into the copulation-pouch, situate, as before described, behind the penis. In the disposition of the parts in Distoma, we observe an advance in point of organization; the testes, in place of being mere stromatoid masses, exhibit more differentiation, and present themselves to our notice as a number of slender vessels tortuously arranged, and terminating in two vasa deferentia, which produce, by their union, a pyriform expansion, the seminal vesicle, that is contracted anteriorly into a sort of projecting penis. On the other hand, the female organs are seen to consist of a vast number of small vesicles, from which lead as many slender ducts, that by their successive union with each other eventually give rise to a simple canal on either side—the oviduct. This, with its opposite fellow, empties itself into an irregularly-shaped utricle, which opens externally by a small orifice posterior to the penis.

The generative organs in the Leech are in a manner like the Fluke's, but less complex in their arrangement. The male portion comprises a number of spherical vesicles, disposed along the lateral borders from before backwards, about twenty entirely. These communicate by short ducts, with two long vessels which lie more externally; these are the vasa deferentia; the latter pursue their course anteriorly, and becoming convoluted at their extremities, form the vesicula seminales, which then terminate in the expanded, internal, or prostatic portion of the penis. The female organs are constituted of two rather extensive, rounded vesicles—the ovaries; these pour their secretion into a pair of oviducts, which, after a brief course, combine, and, forming a single vessel, pass to the uterus, a viscus in outline of the form of an irregular, ovato-lanceolate leaf, which ends in an external orifice—the vagina.

In the arrangement of the circulatory organs, the three creatures present many resemblances. In Polycelis, they consist of two principal vessels, which extend along the lateral margins, and, giving off a large number of minor branches, produce by their anastomosis an extensive vascular net-work, which reticulation, according to M. Duges, is endowed with contractile power. In Distoma the apparatus is of a kindred form, and composed of a vast series of anastomoses, the constituent

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*According to Schmidt, Onophilus verticoides is unisexual.

twigs being derivatives of two larger vessels which lie along the lateral margins, and present very well marked flexures. The vascular system of the Leech, which has been so successfully investigated by Gratiolet, comprises two lateral vessels, extremely contractile, which distribute numerous branches to the surface of the body, these again dividing and subdividing to form an exquisitely minute net-work. Thus we perceive that the vascular parts are not only arranged in the three upon the one common plan, but are very nearly identical in constitution. Possibly it might be objected that the Leech, having scarlet blood, should therefore be placed among the Annelids; but this objection is met by the fact that Piscicola, though most certainly a Leech, is yet, as shown by Leydig, devoid of coloured nutrient fluid; and, also, that by following up this line of argument, Distomum tereticolle should have a place among the Annelids, its blood being decidedly of a reddish hue (Wiegmann's Archiv, 1855); and, finally, the species of Prostoma, discovered by M. Edwards, should be ranked there too, if the possession of scarlet blood were deemed a distinctive character.

With regard to the respiratory function, or the organs that perform it, I may almost state that nothing is known, at least concerning that of Trematoda and Planaria. It is true that much has been written upon the arrangement of the parts composing this system in the Leech, but the descriptions are so loose and so conflicting, that we may almost despair of ever arriving at any positive information upon the subject. Duges informs us that the so-called respiratory canals are in reality nothing more than empty blood-vessels; whilst Müller contends that they are distinct structures, as they do not partake of the general contractions of the vessels, properly so-called.

Again, Williams (on the British Annelids, Brit. Ass., 1851), maintains that those sacculi, formerly looked upon as respiratory pouches, are so intimately conjoined to the duct connecting ovary and testis, as to leave no doubt that they are ovarian vesicles. Finally, Brandt (with whom I am inclined to agree) believes that the quasi-respiratory sacs are organs of special secretion, having observed a whitish liquid escape from their ventral orifices, and that respiration is altogether performed by the general integument.—(Medical Zoolog., ii., p. 250.) If the latter assertion be correct, as it probably is, the analogy between the three groups in this particular is a very striking one.

Respecting the nervous system in these creatures, a decided similarity in form is exhibited; for although some have considered that this system in Planariæ and Flukes is composed of an isolated pair of ganglia, with scattered peripheral filaments, later investigations tend to show that a conformation of parts, approaching to that in the Annelids, exists in these beings also. In the three divisions, we find the cephalic ganglia represented; and these always lie above, or in front of, the oral aperture; the fact of superposition, by which some differ from others, in which proposition is usual, should be regarded as the result, rather of adaptation to a special end, than as a morphological peculiarity. Blanchard, in a valuable paper upon the organization of Worms, which is

to be found in the "Annales des Sciences Naturelles" for 1847, announces the discovery, that the Planariæ have a very distinct and perfect nervous system, which he describes as consisting in a pair of large ante-œsophageal ganglia, somewhat closely adherent; from these proceed a pair of cords, which, after encircling the gullet, pass toward the caudal extreme of the body, retaining, however, their distinctness, and presenting at definite intervals numerous delicate gangliform enlargements, that occasionally produce small nervoid twigs.

In Distoma, a state of parts is seen, which resembles the foregoing; two large cerebroid ganglia lie about the œsophagus, being united by a sort of commissure, and, springing from these, a pair of branches bend their course to the termination of the body, distributing numerous lateral ramifications to the surrounding tissues. Laurer states that, at the point of origin of the branchlets, distinct ganglia are to be found; but this statement has not yet been corroborated. In the Leech, the nervous system is composed of a supra-œsophageal ganglion, connected inferiorly, by a pair of cords surrounding the gullet, with a chain of ganglia situated upon the ventral surface, and united by two contiguous commissures; these ganglia are of very unequal size: some, such as the first and last, are very well developed, whilst the remainder are less or more indistinct. This animal is *said* to possess, in addition, a splanchnic series of nerves. It is manifest that the existence of a great affinity is shown by the above comparison of the nervous structures.

Let us now turn our attention to the method by which locomotion is effected in the groups under our notice; and we observe that, although some exceptions are to be found, the general mode of progression is suctorial. I would look upon the typical, or ideal locomotive organ, as an expanded alimentary orifice, provided with a strong sphincter muscle; this we find has an actual existence in the Liver-fluke, whose suctorious mouth is dilatable, and provided with circular and radiating fasciculi of muscular fibres; it is also to be seen in the common Medicinal Leech, in which the mouth and anus both find their orifices in the suctoria of the alimentary canal. There are also other appended oscula, which seem rather absorptive than locomotive structures.

In Planariæ, the movements are of three distinct kinds: firstly, by the action of ciliæ; again, by a lateral compression of the body and assumption of the piscine form (when a graceful swaying mode of progression takes place, by alternate contractions; this method is similar to that adopted by the Leech when forced to swim); lastly, by means of the proboscidean, or suctorious oral orifice. This latter mode of progression I have myself observed to exist with some large Planariæ, which were confined in a glass jar two-thirds filled with mud; they were in the habit of occasionally ascending to the under surface of the water from the bottom of the vessel, and this journey they effected by attaching themselves to the inner surface of the vessel with the muscular pharynx, and then suddenly approximating the posterior extremity; thus assuming a greater transverse diameter, they would (having retracted the pharynx) again elongate the body, and proceed as before.

The superadded and absorptive oscules are seen in the lateral pores of Tristoma, and in Piscicola and Pontobdella. The provision of cilia is not extended to all members of the Turbellaria, being absent in a great number; a fact which, as Blanchard very justly observes, ought to have been more fully appreciated by Ehrenberg, when basing his class upon such an unimportant and inconstant character. So little has been done in the investigation of their mode of development, that, regarding them in this aspect, we shall find it more difficult to reconcile to our minds the idea of including them within the limits of a single class. Upon an examination of the subject, as it is detailed in Siebold and Stannius' "Vergleichenden Anatomie," we arrive at the following general deductions:—

1. That the determination of the mature form dates either—(A) from the complete emergence of the animal from the egg, or (B) is observed to take place at a much later period, having been arrived at through the medium of a series of metamorphoses. Under the first of these categories may be ranked the Hirudiniei; the second comprehends the Trematoda and Planariæ.

2. In all the vitellus undergoes segmentation, and the ovine embryo is invested with cilia.

3. The three forms of embryo are provided with a discoid sucker, or muscular œsophagus, prior to departure from the egg. It might appear to some that the apparent aggregation of germs within a single ovum, which has been observed in the development of Planariæ, would offer too remarkable a point of difference from the other divisions to be disregarded in their classification; but I need hardly remark that this idea of the multiplicity of germs is an erroneous one,—the fact being that the so-called egg is but an external covering, such as exists among certain Gastropods, which involves a large number of real ova; and this leads me to another very well-marked analogy between these animals and the Trematoda, which is this: the compound cylindric pseud-ovum is the representative of the more permanent zoid, the king's-yellow worm or grand nurse of the Trematoda. The second stage in the development of the Distoma is an extreme resemblance of that in the Planaria, though truly the locality of the animals is vastly different: in the former is observed the cercaria, whilst in the latter the larva assumes to such a degree the character of an infusorium, that it is exceedingly difficult to draw the line of demarcation; indeed, Professor Agassiz has shown that the infusorial genera, Kolpoda and Paramecium, are but the larval condition of some species of Planaria. A confirmation of the analogy between Trematoda and Planariæ is given by the discovery of Steenstrup, that an embryo of Distomum, which inhabits muscular tissue, in every way reminds one of Paramecium. The pseud-ovum is found also with Clepsine.

In concluding my remarks upon the affinities of these beings, I would just call attention to the similarity of habitat presented to us in the lives of the Hirudiniei and Trematoda; both being, almost without an exception, parasitic. Although aware that my selection of the Dendro-

cœli, rather than the Rhabdocœli, may be impugned, I maintain that my choice, if not entirely justified, is at least supported by these two facts: firstly, the ramose-stomached Planariæ have been from every point of view the most completely and accurately investigated of the two; secondly, it is established that many of the so-called species of the simple-stomached are the larvæ of the higher forms.

The following scheme of classification is that which I suggest the adoption of, and is nothing more than a modification of that already employed by Professor Huxley:—

Type.	*Sub-Type.*	*Class.*	*Sub-Class.*	*Order.*
ANNULOSA				
	ANNULOIDA			
		Suctoria	Enterata	Hirudina
			Anenterata	Trematoda
				Turbellaria.

The diagnostic characters of the above class, sub-classes, and orders, may be summed up under their respective heads as follows:—

Suctoria.—Animals depressed, hermaphrodite, devoid of setæ, respiring by integument; locomotion usually effected by a suctorial pore or pores; hooklets for attachment absent; stomach with cæcal appendages; anus absent, or *indistinct.* The orders may be included under two sub-classes. The first receives the order Hirudina, and is characterized by the existence of an intestine and anal orifice; hence it is designated Enterata. The second embraces the orders Trematoda and Turbellaria, and is marked by these peculiarities—the provision of cilia to the post-ovine embryo, and the absence of any intestinal canal. From the latter feature, the term Anenterata supplies an appropriate cognomen. For the distinctions between the orders themselves, the descriptive account beneath may serve:—

Sub-Class.	*Order.*	
Enterata.	Hirudina.	Animals more or less articulate.
Anenterata.	*Turbellaria.*	Creatures non-parasitic, aquatic, or inhabiting humid localities; cilia usually permanent.
	Trematoda.	Parasitic. Cilia absent in adults, undergoing a three-staged metamorphosis.

I now terminate my observations by asserting, that the instance of the quasi-complex Trematode, Diplozoon paradoxum, offers no exception to the general arrangement of these animals, Siebold having lucidly proved the appearance of the paradox due to a pair of Diporpæ in conjugation.

XXXVIII.—On the Cod and Ling Fisheries of Ireland. By Mr. William Andrews. (Plates XIII., XIV.)

[Read before the Royal Dublin Society, Monday Evening, April 16, 1861.]

A paper which I lately gave, at the Natural History Society of Dublin on "The Fisheries of Ireland," was chiefly with reference to trawling on the west coast, and principally confined to the habits and spawning states, and to the localities of the Pleuronectidæ, or flat fish family—not, however, intended to convey the full extent of such a subject, but was more immediately applicable to the characters of the localities where the boundary lines for the prohibition of trawling were presumed to exercise beneficial influence in the protection and security of the fisheries.

The subject of my present paper will be the Ling and the Cod Fisheries of Ireland—one of vast importance in the industrial resources of the country, whether as relating to supplying the very large demand and consumption, or to the extended field of encouragement that it would give to our fisheries by the formation of a body of seamen, an accession of vital interest to the mercantile marine of Great Britain. That these are important considerations, a brief outline of the early state of the British Fisheries will be useful as introductory to the object of my present views.

In 1663 a document was issued by Charles the First, and directed to the Lord Treasurer, and others, desiring them "to erect a common fishery for the nursery of seamen, which contained the first regulations for the governing of his Majesty's subjects inhabiting in Newfoundland, and trafficking in bays;" but from the earliest periods the policies pursued by the Government, especially the Board of Trade, tended much to weaken the position of the original settlers there, and to damp their energy and perseverance in extending the fisheries. The Act, however, of 10th and 11th of William and Mary, declares the fisheries of Newfoundland a beneficial trade to the kingdom, in the employment of a great number of seamen and ships, by the increase of her Majesty's revenue, and the encouragement of trade and navigation. The same parliament came to a resolution, "That the fisheries and trade of Newfoundland do very much promote navigation, increase seamen, and are of great profit to the nation."

In the reign of Elizabeth there were 260 ships employed in the Newfoundland fisheries, and the seamen nursed in these fisheries mainly assisted in manning her fleets. Act 15th, George III., "declares the fisheries the best nurseries for able and experienced seamen, always ready to man the royal navy when occasion may require; and it is of the greatest national importance to give all due encouragement to said fisheries." In fact, from the British fisheries Britain derived the principal means of defending herself; for it had been remarked that neglect and want of proper encouragement to our fisheries would much affect our commercial marine, and consequently our naval ascendancy.

The French saw these advantages to the naval power of Great Britain, and therefore by every influence and exertion endeavoured to obtain equal position and benefit. The French, therefore, spared no encouragement to stimulate their fisheries, gave bounties on the fish exported from Newfoundland, or from France to the French colonies. Bounties were also allowed on all men and boys sailing annually from France, and that were employed in the shore and bank fisheries of Newfoundland. On the other hand, so discouraging had been the countenance of the Government to the British fisheries, that the capitals embarked in them were by degrees withdrawn, and the nurseries of seamen, so justly valued, almost entirely lost. They still more rapidly declined after the treaties of 1814 and 1818, when the greater and the most valuable parts of the Newfoundland fisheries were ceded to the French. The Americans zealously followed the example of France, supported their fisheries by bounties and other encouragements, and thus concurrently with the French sapped the foundation of the British fishery. The British fishermen, being unable to contend with the unequal competition, were left to languish and to deteriorate, being chiefly employed in the in-shore fisheries in small craft, while the French and the Americans prosecuted with vigour the deep-sea fishing on the great banks of Newfoundland,—these powers, it is stated, employing at least 1000 vessels of considerable burthen, and manned with not less than 30,000 seamen.

The valuable report, dated 2d October, 1848, addressed to the Vice-Admiral, the Earl of Dundonald, by Captain Granville G. Loch, R. N., upon the fisheries of Newfoundland and Labrador, when in command of her Majesty's ship Alarm (an ominous name), conveys most forcibly the state of the British fisheries, in comparison with the advantages possessed and maintained by the French. Captain Loch heard the French speak with pride of the sailors their bankers produced, and of the hardships and dangers they were exposed to in fishing on the banks, and that to deprive their country of these fisheries would be to lop off the right arm of her maritime strength.

With this concise review I will now turn attention to our home fisheries, more especially to those of this country.

Through the several reigns from that of Elizabeth to George III. Irish statutes were framed for the promotion and protection of the fisheries in the Irish seas, and the prohibition of foreign vessels from fishing without a license. The system of bounties gaining ground in England was extended to Ireland, and adopted by the Irish Parliament; and by the Act 3rd and 4th George III., 20s. per ton was granted on all deep-sea fish. These bounties, under fluctuating circumstances, continued more or less to influence the Fisheries until the year 1819, when the Irish Board was instituted. At one period we find an effort made by the Government in behalf of the fisheries, under the management of the Dublin Society, through the means of certain duties to be expended in the management of the North-West Fishery. The period of the existence of the Irish Fishery Board was one of activity and usefulness to the year 1829, when its operations with the bounty system were sus-

pended. The effect of pecuniary encouragement to the fisheries was productive of much benefit; it encouraged the employment of larger vessels—stimulated the exertions of more regularly formed fishermen; and, certainly, when we refer to the records of those periods when the consumption of fish as a national diet was far greater than at present, we find that our imports were less in proportion to the demand than they are at the present day, notwithstanding the desire or the necessity for such food has much diminished. The bounty system has in public opinion been condemned,—not, however, denying the good effects that certainly, by its stimulus, tended to a greater extension of the field of our fisheries; but there was a want of system in its distribution that should correct the frauds too frequently occurring in its application.

Subsequent to 1829 the Irish Fisheries began to flag, and unavailing have been all the Commission inquiries to the present period, the fisheries being now at the lowest ebb.

My paper, as I have before stated, is on the Cod and Ling fisheries of Ireland; but before touching on the main features, and some short remarks on the herring seasons, I will give an outline of the average annual imports for the last few years.

From the returns supplied by the most eminent in the trade in this country the imports of ling into Ireland, principally Shetland are,

	Tons.
To the Port of Dublin—Cured Ling,	600
Do. Belfast Do.,	300
To other Ports of Ireland, Do.,	300
	1200

And this quantity, at the lowest wholesale figure, £23 per ton, represents an annual outlay from the country of £27,600. The price has been as high as £28 per ton, and the retail price 32*s.* per cwt. Of the above quantity, Messrs. Bacon and Co., of Ship-street, have imported 300 tons. There is also a quantity of Newfoundland cod imported into Waterford. We will now see in round numbers what are the annual imports of herrings into Ireland—

		Barrels.
To Dublin,	about	20,000
Belfast,	,,	20,000
Derry,	,,	6,000
Newry,	,,	4,000
Drogheda,	,,	2,000
New Ross and Waterford,		2,000
Limerick,	,,	7,000
Cork,	,,	5,000
Galway,	,,	4,000
Sligo,	,,	4,000
		74,000
Those in bulk about,		6,000
Making a total of		80,000

and these at the retail price during the past month, 32*s.* per barrel, would amount to £128,000. This must appear as astonishing and melancholy evidence of the state of the fisheries of our country, whose sea-coasts present an inexhaustible supply, incessantly reproductive.* Papers given in the Natural History Society of Dublin, have shown how largely reproductive are the results of improved modes of fishing, and the extent to which the Dublin markets have been supplied. Although around the coasts of Ireland the cod and ling fishing-grounds are good, yet through the desultory mode practised in most districts by those whose occasional pursuits are land labour and fishing, the supplies obtained are not equal to the demand, from the insufficiency of their boats, and their want of knowledge of the deep-water soundings. It is only necessary to allude to those main features of the fishing-grounds of the coasts of this country, where the banks of soundings are productive to an extent that would not only meet the very large imports now annually required, but would likewise in time afford an export trade of mercantile value. The questions, then, are—What systems would be the most successful, and what positions the best circumstanced? In a paper already given on "Trawling and its Effects," I have strongly alluded to the importance and advantages of a large class of boat, that could at any season be turned to profitable fishing, whether in trawling in the bays of the west coast during the frequently stormy seasons of the spring months, or outside the headlands and in deep-water soundings during the summer months for the cod and ling. It is, therefore, very important to select such stations that would be near to the best fishing-grounds, have harbours of safe and easy access, and where quick and moderate charges of transit would place the position within the reach of good markets, and where the general modes of trawl, long-line, and the herring fishery, could be turned to the best account, so as to keep the vessels and men continually employed in fishing and fish-curing throughout the year.

In speaking of fishing-banks, a term erroneously applied (for it is mere variation of soundings), we have to seek those grounds where the depths are suitable, and where clear and sandy soundings are to be met fit for the trawl nets, or where corally or gravelly soundings, most abounding in marine animals, as Crustacea and Mollusca, are the resort of the ling, the cod, and the haddock, consequently the most productive to the long-line and the hand-line fishers. Excellent grounds for cod are on the north coast, especially off Portmore, and at Culdaff; but the most prolific grounds for cod and ling are off Tory Island, on the N.W. coast of Donegal, in twenty-seven to forty fathoms. The insecure shelter afforded by Tory Island (being safe only with southerly winds), and the too great exposure of Sheephaven, with the remoteness of markets,

* That I have much under-estimated the imports to Ireland, may be seen by the following statement, since received from the Harbour Office, Belfast. There were imported to Belfast, in

		Tons.		Barrels.
1858, . .	Cured Fish,	657	Herrings, . .	15,489
1859, . .	,,	682	,,	16,956
1860, . .	,,	751	,,	22,568

would not yield the encouragement necessary to establish a permanent station. We must, therefore, for the present depend upon the Bays of Galway, Dingle, and Kenmare, as affording the best positions for remunerative mercantile traffic.

Some years since, more particularly at the time when Government bounty was given according to the quantity of fish taken, and to the tonnage of the vessel, fine wherries, averaging sixty tons, annually went to the Bofin bank, off the coast of Mayo, making their rendezvous the safe little harbour of Innisbofin. Captain Borough, R. N., who commanded one of those large class cutters, at that time cruising on the west coast for the suppression of smuggling, informed me that he had seen large piles of ling, cod, haddock, and conger, which had been dried on the shingly beaches of Bofin; and it was no uncommon occurrence for the wherries to complete their cargoes by the end of July. These, though inferiorly cured to the Shetland ling, had good demand, and very materially aided in meeting the consumption of the time. The Island of Innisbofin affords the best position on the west coast for carrying on the summer cod and ling fishing, which generally begins in April or May, and ends in July or August. The island possesses a fine natural harbour on its southern side, having sufficient scope for several hundred boats, and with a depth of ten feet of water, the ground being soft and safe for lying on. The entrance could be most easily improved, and rendered of easy and safe access. The Nepean King's cutter, of 180 tons, had frequently been in Bofin Harbour.

The in-shore fisheries of Bofin, Cleggan, and Ballinakill can be carried on during the spring months close in with the land, in ten to twenty fathoms, when the fish approach to spawn; but the best fishing banks are the soundings, at a distance from the land, in thirty to sixty and seventy fathoms, where the ling, cod, and haddock are, like the great bank of Newfoundland, inexhaustible, and where on the feeding-grounds in the deep water they are taken in the finest condition for curing. The best ground is west and north-west of Bofin Island; the fishing-soundings vary from thirty to seventy fathoms, and extend from ten to sixty miles from the land. In ranges north-west of Bofin and south-west of Achill-Head, and again southerly off Slyne Head, these grounds can be easily fished; and the harbours of Bofin, Ballinakill, Cleggan, and the northern shores of Galway Bay, afford safe runs, according to states of wind and weather. The gravelly soundings and sand and shells which constitute these banks, and covered with myriads of animal life, form the feeding-grounds and resort of the finest cod and ling throughout the year, until the instinct for propagation brings them to in-shore localities.

These are also the ranges of the basking shark or sun-fish (*Selachus maximus*), which, feeding on the loligo, cuttle-fishes, and other mollusca, the sun-fish grovel on such grounds until at certain seasons, for the development of natural causes, they rise to the surface, when at the morning and evening in calm weather they may be seen listlessly and sluggishly floating, their dorsal fin and back exposed. The structure of the branchial apparatus, the wide orifices protected by strong defences of a pectinated or comb-like grating, and their blunt and small teeth,

peculiarly adapt them to the mode of existence, and suit them to the food they seek at the depths they frequent. In the latter part of April and beginning of May these natural causes affect the sun-fish; and thus, when the vessels are at that season employed in line-fishing, they may frequently meet and capture these fish on the range of banks from Achill, coast of Mayo, to the Brannock Isles off the great Arran Island. Boats suitable for this should not be less than fifty to sixty tons, provided with two good boats, sun-fish spears, and harpoons, with ample coils of line; and these vessels, each manned with eight men and two boys, would meet certain success in the capture of these fish when following the cod and ling-fishing. A large sun-fish frequently yields six to eight barrels of valuable oil, of thirty gallons to each barrel. More than 100 sun-fish were seen off the coast of Mayo, the present season, within two miles of the land. Five were captured, even with the very indifferent boats and gear used by the natives.

To the Galway or Claddagh hookers the capture of a sun-fish is mere chance, as they are never sufficiently found in provisions or means to remain any time at sea on the distant ground, chiefly preferring nearer home, and fishing in excellent soundings in thirty to forty fathoms to the south and south-west of the Island of Arran, where they have taken good supplies of cod, ling, and haddock. There are also excellent fishing-grounds off the Blackrocks and Iniskea, to the north-west and north of Achill. The neighbouring bays of Blacksod and Belmullet, abounding in fish, clear for trawling, and for obtaining bait, are too remote at present for the objects of carrying out a general remunerative fishery.

So important were these fishing grounds, that the Dutch, until they were beaten off during the period of the Commonwealth, annually employed large vessels there, and old Dutch charts mark the soundings and bearings of the fishing-banks. In 1793, when the French were driven from the banks of Newfoundland, they fished off the west coast from Tory Island to Innisbofin, and soon completed their cargoes. Since the men of Skerries have ceased to work with their wherries on those banks, and the Claddagh hookers are no longer equal to the deep-sea fishing, a petty system is followed within the Arran Islands, and the headlands of the bay, with the small hookers and canoes, which they can only now fit out for the day's fishing. The Glenina men, who mostly fish at the entrance of the bay and about the Arran Isles for the take of ling, cod, glasson, hake, bream, and grey gurnards, have but indifferent canoes, with three men in each, using small spilliards and hand-lines; and sad have been the falling off of the hookers and canoes that once filled the harbour of Killeaney, in the Great Arran. Even along the iron-bound coast of Clare from Hag's Head to Loop Head, the stations of Seafield, Baltard, Farrihy, and the entrance of the Shannon, each sent forth hundreds of canoes, manned by hardy and daring fellows, who, before the suppression of smuggling, watched the hoverings off the coast of the Big Jane, the Blue-eyed Maid, and the round O. In those days abundance of large haddock were sold in the town of Kilrush at 3d. each, and fine turbot at 6d. to 1s. each, the supplies being abundant. Now depopulated and silent are those shores that once displayed their

long ranges of well-found canoes. Emigration and the poorhouse tell their tales.

The next part of the coast of interest to refer to is that of the Bay of Dingle, equal in importance in its deep-sea fishing-grounds to that of Bofin, and superior in its position, in the concentration of its capabilities as a general fishing-station, yielding large supplies of the most esteemed kinds of fish for the Dublin markets, as well as the most extensive resources of cod, ling, haddock, and hake, which could be turned to great mercantile account. So well were these grounds known to the French, that Duhamel, in his 'Traite General des Pesches,' vol. 2. p. 46. 1772, observes—"La partie du Royaume d'Irlande la plus abondante en Morue est à l'ouest, aux environs de la baye Dingle; elle se fait depuis la S. Michel jusqu'au mois de Mai."

Having given a paper with reference to its trawling, I shall concisely touch upon the soundings off the coast where the cod and ling are most abundant. A fine bank bears about north-east half east off Smerwick Harbour, extending about five to fifteen and twenty-five miles north and south—the soundings forty-two to forty seven fathoms—shelly gravel, mixed with coral. Abundance of marine animals are taken in the dredge, prawns, shrimps, crawfish, and numerous crustacea, hermit crabs, unprotected by shells, sepias, and loligos, and other mollusca, which form the feeding grounds of inexhaustible numbers of cod and ling. Inside Ballydavid Head, Smerwick Harbour affords tolerable shelter. Close in-shore, off Brandon, the canoes of Ballyguin have their favourable seasons, and take cod, haddock, and ling. Off the North Blasket, a few miles to the north-east, the Bor-a-liath sands abound with ling, cod, and conger. Westerly, and north-west of the Tiraght Rock, and the westernmost Blasket Island, soundings have been run out to sixty and eighty fathoms, at ten to twenty miles from the land, of fine shelly gravel, and where very fine cod and torsk have been taken in July, superior in size and firmness to the fish of shoaler depths. In the run of the tide outside the south-west entrance to Valencia, from Bray Head to Puffin Island, in thirty-three to thirty-five fathoms, immense quantities of ling and cod can be taken from February to May, and during the summer months in deeper water to the north-west of the Skelligs.

I have now concisely touched on those grounds outside the headlands of the peninsula of Dingle and of the Island of Valencia, where in the greatest abundance cod and ling in perfection of condition for curing can be taken. At present the Dingle fishermen have only canoes and a few sprit boats to follow the ling and cod fishery, and those of Portmagee a few canoes. It is quite clear that only in moderate weather, and during the periods of the year that the fish come close in land to spawn, that they can venture to look for them.

In February the ling and cod come into the bays, and approach the shores to spawn; and, during the months of February and March, deposit the spawn in rough and corally grounds, where the ova are protected from the influence of tide or surf. In fact, along the entire coast, in the rocky and corally soundings of shoaler grounds, the fish spawn. In April the spawning conditions of the fish are nearly over, and early

in May they again have returned to the deep water, the feeding-grounds of those banks that I have already referred to. The large quantities of ling and cod taken in Dingle Bay, and by the Portmagee fishermen, are never met with in that condition equal to those taken and cured during the summer months at Shetland, or on the banks of Newfoundland. When the fish come into the bays, they remain where feeding is obtained until instinct forces the deposit of spawn, and causes their resort to the grounds suitable to the protection and development of the ova. They quickly recover from the spawning state, and retreat to, and are again taken on the grounds in the bay before they move into deeper water.

It is now an established fact that since trawling has been carried on in Dingle Bay, the takes of cod, ling, haddock, and hake, have not each year been less productive or diminished, but rather have increased—sometimes taken in quantities even where the trawlers are working off Ventry Tower on the north side, and at other times according to weather on the south side of the bay. Last year (1860), the cod and haddock were so abundant in the bay as to fill the canoes in half the day, when the weather answered. Returns show that from the 20th of December, 1859, to the 20th of March, 1860, the average takes of cod and haddock were fifty pair per day to each canoe; and when the weather was moderate, the canoes frequently came in full by one o'clock. With large boats and ample lines, what would not be the results?

It is also remarkable, that the crews of seven to nine canoes have brought them from Brandon Bay, where trawling is altogether prohibited, to Dingle, to fish in that bay with spilliards and hand-lines.

My esteemed and regretted friend, the late Rev. Charles Gayer, of Dingle, who was most strenuous in his exertions to promote the fisheries there, mentioned in one of his many communications to me that in the summer of 1847, he had been trying the soundings westward of the Blasket Islands, and that he had found fine gravelly soundings, nearly twenty miles from the land, in sixty fathoms. In 1848, the Admiralty, most desirous to aid in every way the fisheries of this country, directed Master and Commander Aylen, in the Rhadamanthus, to run out soundings to mark the depths of the supposed banks off the Shannon and the Blasket Islands; and subsequently Commander Wolfe, in the Zephyr, ran a line of soundings from Dingle Bay and the Skelligs. These are, however, only of importance as showing the variation of depths and ground, and do not convey any usefulness with regard to the most likely soundings for seeking fish, which alone can be determined by the practical zoologist.

Anxious to continue these inquiries, I made, in the summer of 1850, several trials of soundings westward of the Foze and the Tiraght Rocks. In running out these soundings, we found excellent fishing-ground, sand and shells, 65 fathoms, the Foze bearing S. S. E., seven miles, the Tiraght Rock bearing E., eight miles, 63 fathoms. The Foze S. E. ½E., coarse sand and shells. The Foze S. E. by E.—Tiraght E. and by S.—eight miles, 68 fathoms, soft sand and mud—nine miles, 75 fathoms, rocky ground.

At the distance of from nine to twelve miles, the Foze and the Tiraght present remarkable features to vessels from the westward. The group which Plate XIII. represents gives the Tiraght, the great Blasket Innisnabroe, Innismacilaun, the western Blasket, the most western land in Europe, and the Foze. The Foze bears by compass S. E. by E., the Tiraght E. and by S., showing the singular perforation through it; and the Great Skellig can be seen, bearing S. and by E.

The Tiraght (see Plate XIV.) is a most conspicuous mark to vessels standing in for the land, having a large perforation or passage through the island. This rock has an elevation of about 600 feet, and contains 47 acres. It bears nearly seven miles W. N. W. of the Great Island.

In the month of July of that year, having on board two picked crews of Dingle men, with their canoes, we ran out soundings north and by west of the Tiraght Rock, ten to twelve and fifteen miles. Soundings of shells and gravel were found in fifty-five and seventy-five fathoms. With a small dredge, almost useless in such depths, were obtained numerous minute Crustacea, *Hyas coarctatus*, and living specimens of *Mya truncata*, usually a shore species, *Fusus Islandicus*, also *Loligo vulgaris*, and beautiful specimens of *Onuphis*, the antennæ of most brilliant colour, and the rings of the body most delicately marked. The beauty of these objects is completely lost in spirit preparations, and shows how necessary in the recent state to have a correct knowledge of generic and specific differences; for the spirit preparations of the marine zoology of our deep-water soundings, which are brought home for subsequent examination, are so altered in membranous contractions, and in colour, as to lead to deceptive conclusions of their true characteristics. Many very minute and delicate crustacea and mollusca are obtained in deep water, even in 80 to 100 fathoms; and it is remarkable that the peculiar features of marking and colouring are more vividly and distinctly defined in species so obtained than in those from shoaler depths. In *Hyppolyte*, a species exhibited the body beautifully transparent or diaphanous, while brilliant azure and crimson lines were most intensely shown.

On these grounds our lines were set, each canoe having about 1200 fathoms of line, with 800 hooks. The bait used was fresh herring; and on the lines being hauled in the evening a large quantity of splendid cod and torsk (*Brosmius vulgaris*) were taken, the latter a northern fish, and rare on the British coasts. These fish, as stated in the certificate of Mr. Robert Brown (one of the best Scotch curers introduced into Ireland), were in point of size and condition finer than he had at any time seen brought in. We also took the black-mouthed dog-fish (*Pristiurus melanostomus*), a rare British fish, but appearing there to be by no means uncommon. The young were also taken with the vitelline sac attached. It was here also that specimens of *Sebastes Norvegicus* were taken, sure indicators where these fish frequent of good cod fishing-grounds. The stomachs of the cod were gorged with portions of loligo (the common squid), with *Hyas coarctatus*, and masses of the prawn (*Palæmon serratus*) also *Pandalus annulicornis*. The herring bait, however, to the cod and the torsk, was irresistibly attractive.

I must here bear the strongest testimony to the steadiness and good conduct of the Dingle men in this their first cruise at sea, and of the superior intelligence of one of our principal fishermen, Eugene Moriarty.

The banks off Ballinskelligs Bay, inside and outside the great Skelligs, off Kenmare Bay, and the Lack bank, thirty miles off Berehaven, were well known in former days to the Kinsale men, who, in fine hookers of twenty to twenty-five tons, frequently fished there, and were styled on the coast Capers, from coming round Cape Clear.

The last that I shall allude to is the Nymph Bank, lying midway between the Irish and English coasts, and trending along the Irish coast from Hook lighthouse, and round Cape Clear, as high as the Durseys. The fish on parts of this bank are most abundant, but the soundings are irregular, with shoals and steeps, and it altogether depends upon the character of the soundings for detecting the best feeding-grounds. The promising success of the Nymph Bank or Waterford Company, and its dissolution in 1804, from disagreement among the directors, have been often alluded to. The harbours of Glandore and Castletownsend are good positions for fishing the bank.

I have endeavoured concisely to give these details; but it was necessary, on such an important subject, to show fully the resources we have at command, and now to place before you the position and the means we have of availing ourselves of them. I have carefully gone through the Fishery Reports, from 1836 to 1848; and, although conveying much valuable information, yet there are such masses of collected evidence of interested and contrary opinions, not grounded upon either sound, practical, or scientific knowledge, that no tangible points can be found from which to derive any beneficial practice. So far back as 1825, the Commissioners of Fisheries, in their Report from the Irish Fishery Office, dated 12th May, expressed sanguine hopes that they might see fishing companies established on an extended scale. "By such associations the productive fishing-banks which surround the coasts of Ireland may be fairly tried, but which, from want of capital and suitable craft, have hitherto been but imperfectly ascertained, and only casually visited."

In the fearful years of 1845 and 1846, when cholera and potato failures depopulated entire villages on the west and south coasts of Ireland, exhibiting the desolation of tenantless and roofless cabins, the fisheries were almost given up as a noxious employment. In 1846, Mr. Trevelyan, of the Treasury (now Sir Charles Trevelyan), feeling deep sympathy for the miserable state of the Irish poor, and desirous in every way of aiding the Irish Fisheries, had many communications with Lieutenant-Colonel Jones (now Lieutenant-General Sir Harry Jones), then Chairman of the Board of Public Works, which resulted in a grant from the Treasury of £5000, and which in December, 1846, was applied in forming curing stations, and for the purpose of giving aid to the fishermen on the west coast. These stations, however, ill chosen, were by no means adapted for the objects intended, and the Scotch curers that were introduced had no interest nor desire to see the Irish fisheries promoted; and as no knowledge was brought to bear to direct them, they resulted

in failures, and were finally brought to a close before the end of August and of December, 1848. Sir Charles Trevelyan, however, did not cease his desire to relieve the fishermen and the coast population, "by encouraging extra employment in the fisheries in Ireland." At that period I addressed a letter to the late Admiral Sir Thomas Ussher, dated 6th May, 1847, pointing out the extreme wretchedness of the coast population, and the importance of the fisheries of Ireland,—in fact, advancing the principles of the views I have now submitted. This resulted in the formation of the "Royal Irish Fisheries Company,"—a royal charter having been obtained through the Earl of Clarendon, and through the warm support of the Marquis of Landsowne and Sir Charles E. Trevelyan. It commenced operations at Dingle, in the autumn of 1848, where existed (as Mr. Donnell, in his Report on the Fishery Harbours correctly states), "a large population of real fishermen, exclusively employed in the fisheries." The wretched state of these poor men and their families, their ill-found heavily fitted sprit-boats, requiring six to seven men and a boy to each, and their almost total want of all means of fitting out their boats, and of arrangement to fish with regularity, required the most prompt and energetic systems to stimulate their industry.

In the spring of 1848, the extreme miseries that existed along the coasts of Ireland, from Galway to Kerry, were melancholy tales. Able-bodied men died of starvation; their families were without food, clothes, or fire; while, as expressed in a letter from the Arran Isles, "the sea swarms with cod, ling, and glasson." Dingle nearly equalled this wretchedness. By well-timed assistance, the Dingle men were again roused to activity—trawling was introduced into the bay with most successful results, improved systems of long-line and hand-line fishing were practised, large and well-built canoes were found for the men, well supplied with long-lines, their fish was bought, and Dingle men and its bay amply repaid these exertions. In a few years, the fishery at Dingle assumed a flourishing position. The curing-houses and stores were in admirable and neat order, the former under the management of Mr. Robert Brown, a Scotch curer of high qualification, and skilful cooper (and who, it is right to say, was recommended by Mr. Ffennell, Inspecting Commissioner of Fisheries), the latter in charge of Mr. Eugene Moriarty, an experienced Dingle fisherman. With every trial and care in the curing of our fish, I was enabled to obtain from Messrs. Bacon and Co., of Ship-street, the following gratifying communication:—

"*Ship-street, August* 31, 1852.

"DEAR SIR—We have always been desirous to see the industrial resources of this country encouraged, and especially the fisheries, and therefore are much gratified to say that the ling cured at your station at Dingle this year is not inferior to the best Shetland ling, and superior in weight, quality, and appearance, to the best Rush-cured ling, and to that fish taken on the north-west coast of Ireland. If we find that it keeps equally well, we would be glad to purchase a cargo from you. Wishing your undertaking every success, we remain, &c.,

(Signed) "THOMAS BACON and Co.

"*To Wm. Andrews, Esq., Royal Irish Fisheries' Company.*"

The following year, a most gratifying confirmation of the value of the fish was again given by Messrs. Bacon and Co. These results were achieved without capital, mainly through the voluntary subscriptions of a number of gentlemen, a great portion of which money was absorbed by the expenses of the charter. No shares were called in, nor liabilities to the promoters; and in six years from the date of the formation of the project, its position and plant were valued at £3000. Subsequently it was possessed by others, its decline became apparent, and a project commenced under the most favourable auspices and high support finally came to a close.

At the period of the greatest distress, in 1847, Lady Carberry, to relieve the fishermen of Rathberry, in the county of Cork, advanced the sum of £189 12*s*. for the purchase of seven large yawls and their fitting out, as well as advances for clothing for the men and their families. The return of the sales of the fish taken by these boats from the 12th April to 7th July, 1847, realized £399 19*s*. 11*d*. An intelligent English coast-guardman, James Morley, of Dirk Cove, Clonakilty, had the superintendence. Morley states that the weather being fine, one of the yawls went to the outer bank, a part of the Nymph, and in one shot of their lines, to their great astonishment, filled the boat. They fell in with a Kinsale hooker loaded with large fish. These minor operations plainly evince what with certainty can be effected to an enormous extent by large boats, fitted to keep the sea.

The miserable state of the fisheries at Valencia and Portmagee, where such splendid fishing-grounds are around, can be easily explained, because at the best seasons of the year their wretched canoes and yawls are unequal to the seas; and such may be said of the present state of the greater part of the fishermen at Dingle, who, through the reverses of weather, crowd the poor-house. Around the coasts of Ireland similar tales may be told. It is only in such districts where trawling has been introduced, as at Waterford, Dingle, and Galway, and in Dublin, where the splendid vessels of Mr. Good, which outrival the English craft, and are supplying our markets, that any improvement in the fisheries is seen.

The men of Skerries and of Rush, who once followed annually the deep-sea fishery, and when the bounty was given, large quantities of ling and cod were brought home and cured at Rush, still inherit the desire to make their north-west cruises. In 1853, this spirit stimulated them to fit out four vessels for Iceland; but not having good information when on the grounds, and being late in arriving there, they were not successful. French vessels had made good their fishing before the Skerries' boats were prepared. In 1855, three vessels were again fitted at Skerries, averaging fifty tons each, with a crew of eight men and a boy. In each vessel were two men from Greenwich, who knew the navigation and the fishing-grounds. The vessels had equal success. The first that returned had 21,000 cod, with a large quantity of oil. The bait was the halibut, the Helgar Fiskar, of Iceland. The weather on the fishing-grounds was changeable and foggy, with heavy swells. They left in April, and were

twenty-one days going out; and returned in August, nine days coming home. If the weather had been favourable in the commencement, they might have completed their cargoes in two months. This is the way to make fishermen, and to form seamen. The poverty of the men at Dingle, and other places on the west and south-west coasts, make them able only to fit out canoes, to the almost extinction of the sprit-boat and the hooker. The consequence is, that the herring fishery is much on the decline. And what can this wretched system avail, with their few hundred fathoms of spilliard line and the sceltane of hooks, on those abundant fishing-grounds? It is not that they are unequal as seamen and fishermen, but it is their poverty, and the absence of all encouragement to fisheries. Compare this with the vessels that fish the coast of Iceland, Norway, the Orkneys, and the Well-bank, the Dogger-bank, and the Broad Forties—vessels ably manned, well found, and with twelve miles of lines, who fish the Dogger-bank, in the North Sea, 150 miles from land, remaining months on the ground at anchor or hove-to, weathering heavy seas and heavy gales. A fine vessel I saw at Greenwich, of 66 tons, had eleven miles of long lines, with hand-lines and nets, had ample stowage between decks for salt and curing fish, and could bring alive in her well 2000 cod fish.

When Government aid and protection were given to our Newfoundland and Labrador fisheries, we had vessels of 250 to 400 tons working throughout four months of the year on the great banks, in dense fogs, and a perpetual and heavy swell. These employed a large number of seamen—they remained at anchor on the banks, veering out 120 fathoms of cable, and sometimes in heavy weather having 200 fathoms of cable on end. In gales they weighed and hove-to. Since the withdrawal of all encouragement, the trade is principally carried on in the in-shore fisheries by boats of nine to fifteen tons. The encouragement given by the French Government of several millions of francs a year to the Newfoundland fishery, enable the French to keep on the banks vessels of 300 tons, manned by at least forty men in each, and found with seven to nine heavy anchors, and upwards of 800 fathoms of hemp cables. These vessels have each four to five large boats, that can stand heavy weather, lines that cover a great extent of ground, and numerous nets and fishing tackle; 17,000 to 20,000 of these men return to France every winter, and are ready to serve the imperial marine. The bounties given by France are not for the advancement of trade, but to create a navy.

In October, 1857, it was stated that Sir G. B. Pechell, M. P., intended to bring under the consideration of Parliament, in the approaching session, the whole question of the fisheries of France. Within a few days of that month, twenty-one vessels had arrived at Marseilles with 2,357,000 kilogrammes of cod fish.

The best boats suited to the coasts of Ireland are vessels of forty to sixty tons, well supplied with long-lines, and with nets, and a small dredge-trawl, to obtain herring, mackerel, and other baits. The line-fishers on the different parts of our coasts find it extremely difficult to obtain bait, especially in the rough weather of the winter and spring

months; and it was not until trawling was introduced into Dingle Bay, that the fishermen could get any regular supply. The formation of mussel-beds had been absurdly urged—it would not pay the care and expense. In the cod and ling fishery the mussel is useless—it is only successful in the taking of haddock, whiting, and bream. Large quantities of mussels are dredged in Castlemaine Bay, and are used as a top-dressing to the land—*Mya arenaria*, the Clam; *Tapes decussata*, called in Kenmare Bay, Budherees; *Mya truncata*; *Fusus carinatus*, and *F. despectus*, *Buccinum undatum*, are all excellent baits, and can be obtained in great abundance in the localities where they exist; but no baits are equal to the herring, the sprat, mackerel, the conger, and the sand-launce (*Ammodytes lancea*). For the Newfoundland fisheries, enormous quantities of bait are required; and it is a serious expense to the French bankers, who are obliged to buy large quantities of the capelin (*Mallotus arcticus*) from the British. Early in the season herring bait is obtained; the capelin strike into the bays about the middle of June; and these are succeeded by the squid, the herring, the sprat, and the sand-launce.

The clam bait, *Mya arenaria*, are salted and barrelled in large quantities for the Bank fisheries. These, with *Pectunculus glycemeris* and *Mya truncata*, are also valuable.

The herring can be easily taken in May, when the cod and ling fishery off Bofin, and on the coast of Kerry, would be in perfection. I had intended making some comments upon the herring and mackerel fishing, but it is too important to do more at present than make allusion to it. All along the coast from Achill to Berehaven, herrings and mackerel are off the coast in deep water long before they enter the bays, and can be taken in the finest condition by vessels of proper tonnage with deep nets. The herrings or mackerel do not come in-shore in our bays and estuaries until near to the approach of spawning. In the month of June, off Puffin Island, coast of Kerry, our vessel passed through immense sculls of herrings, when none had entered the Shannon, Tralee, Dingle, or Kenmare bays. Off Dunmanus Bay, at the entrance of Kenmare Bay, I saw large numbers of pilchards. Mackerel on the west and south coasts have ova well developed early in April, in Dublin Bay in Mayo. Large quantities of herrings are frequently off Valencia, and the entrance of Dingle Bay, during the month of May, when not a single fish is taken there or in Galway Bay earlier than July, and sometimes August. I have seen large quantities of mackerel off the Arran Isles, when not a boat in Galway had taken any. The *Cork Constitution*, dated March, 1852, states that "There is now in Crookhaven a French fishing vessel of 44 tons burthen, with a crew of 20 men, who, with their nets, have tried the mackerel fishing on the coast of Cork, within thirty miles of the Cape; she took in a few nights, and with very indifferent weather, 50,000 fine fish, which she salted in a bulk, and is about to sail to France."

Having pointed out the imports we annually require for this country, the capabilities of our resources to meet those demands, and the position

we are in to avail ourselves of them, it remains to consider what are the best aids that can be rendered to us—whether through public legislation or through private enterprise. The proceedings of the Irish Fishery Board up to 1830, stimulated the fisheries to a successful extent, and the productive bounty on fish was valuable to the poorer classes of fishermen. The loans granted, in accordance with the Report from the Irish Fishery Office of 12th May, 1825, and the public notice of 5th January, 1827, could at that time be taken advantage of by the fishermen with beneficial results. The present state of extreme pauperism of the fishermen render it questionable whether they could repay the loans that would be made. Private enterprise has had so many checks by ill-managed projects, that these failures have had the evil tendency of causing a general want of confidence in such speculations; hence the difficulty of obtaining that pecuniary support so necessary for the proper development of one of the most important branches of our national industry.

Within the past week the *Moniteur* contains a long report to the Emperor of France, from M. Coste, of the Institute, 'On the organization of the Fisheries as regards the increase of the Naval Force of France.' He alludes to the large annual grants made for the encouragement of the fisheries; and recommends that associations should be formed around their coasts for extensively carrying out the fisheries; and as the fishermen have not the funds to do this, he suggests that advances shall be made them, by what are called the *Maritime Caisses de Retraites*, subject to the condition of paying back three per cent. per month of the produce of their fishing, in addition to the three per cent. they are already bound to pay to the said *Caisses*, in order to obtain relief in sickness or old age. Proper encouragement would prevent the emigration and the annual falling-off of our coast population, while others fill the poor-houses, and yet there are many that regret their exile, and sigh for their native land. The *New York Express* of November, 1857, states :—"A large number of the Irish population of Newbury are returning to Ireland. By industry and economy many of them have acquired means, and in view of the favourable condition of the old country, start off with the determination of spending the remainder of their days at their early homes."

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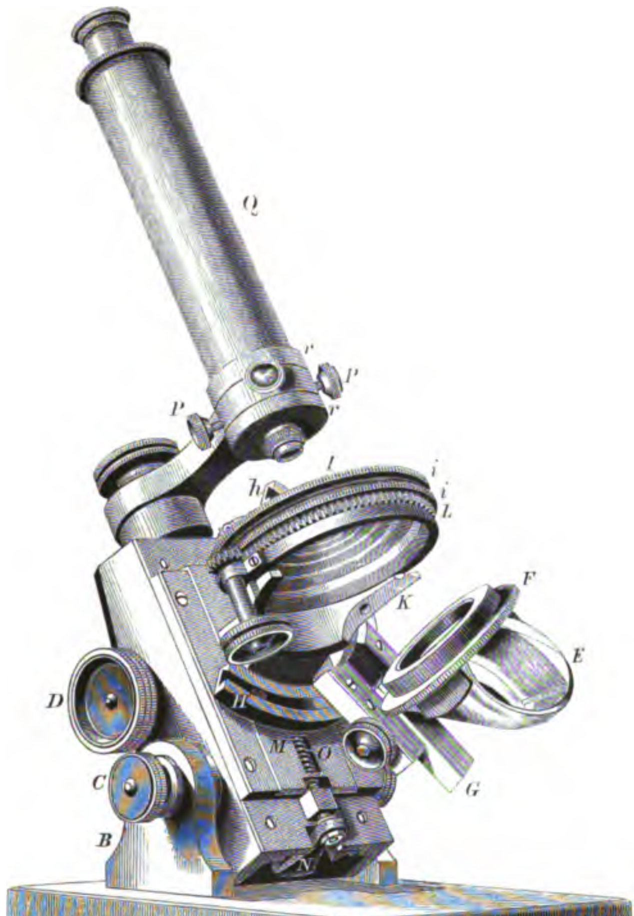
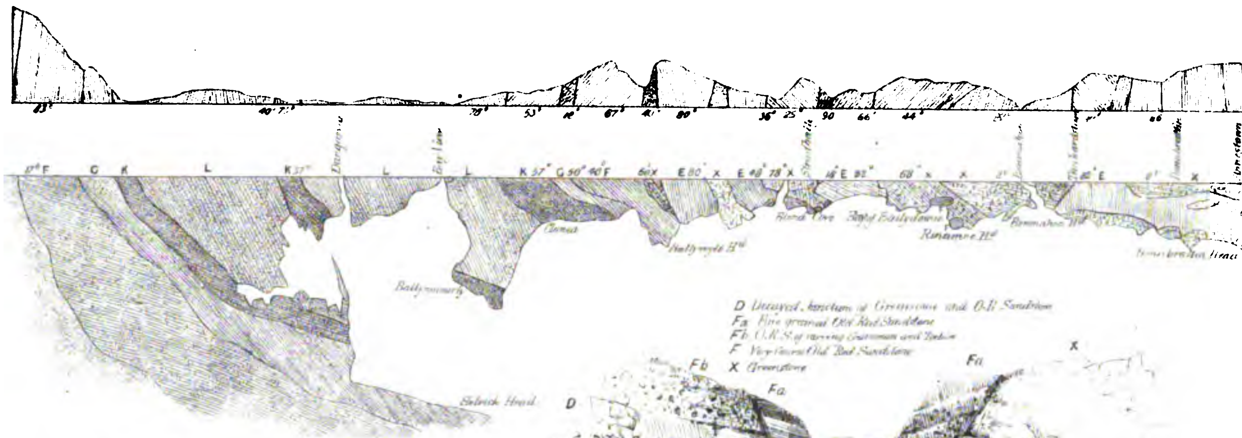


MR. GRUBB'S NEW COMPOUND MICROSCOPE.

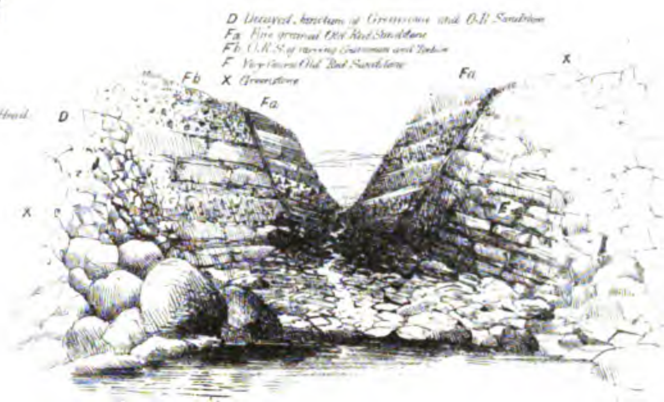
SECTION FROM HELVICK HEAD TO ANNESTOWN Co. WATERFORD

Scale 3 Miles to One Inch



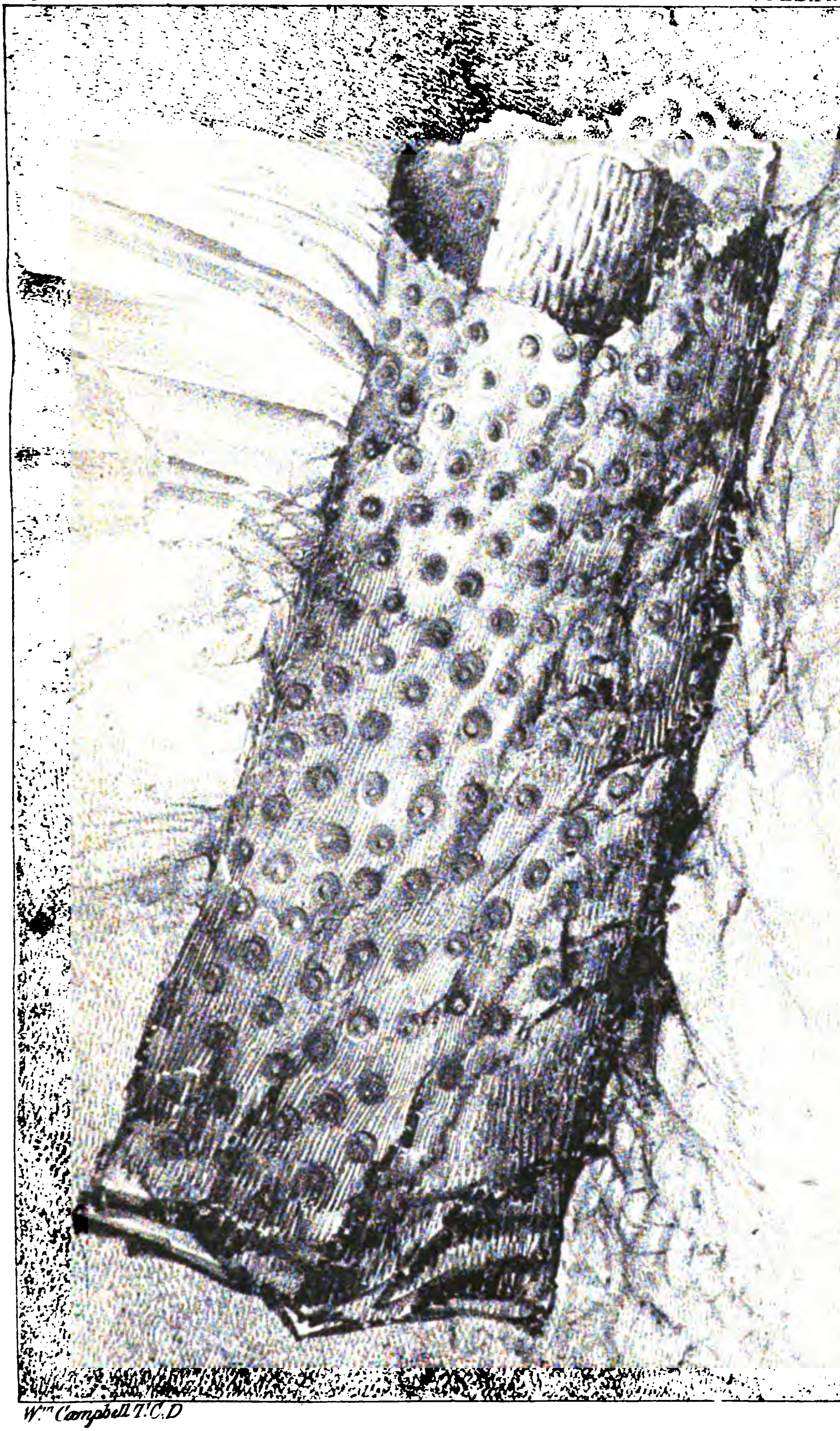
Reference

- X Greenstone
- E Silurian
- F Old Red Sandstone
- G Yellow Sandstone
- K Carboniferous Shale
- L Limestone



VIEW OF CLIFFS AND SEASHORE

W. Campbell T.C.D.



W.m Campbell T.C.D

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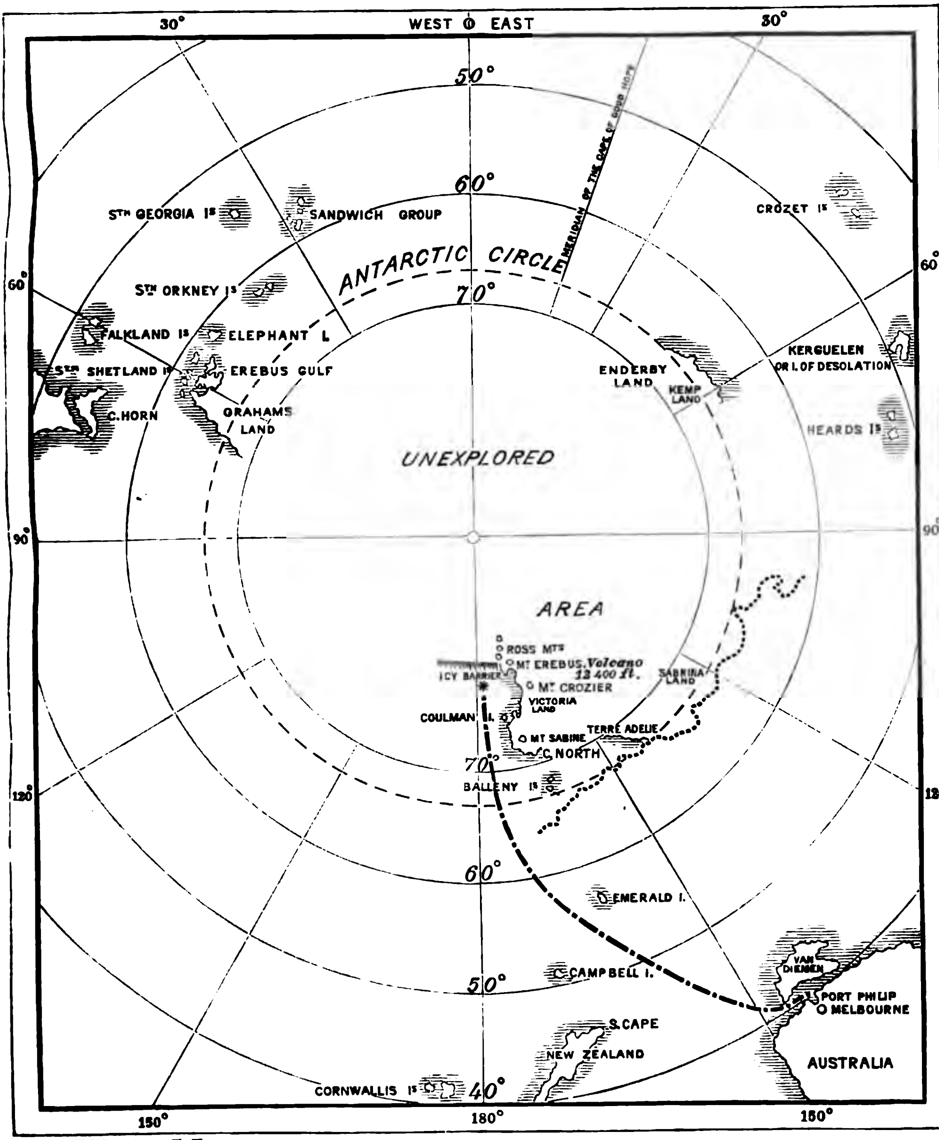
ANTARCTIC DISCOVERIES



Lionel J. Fleming C.E.

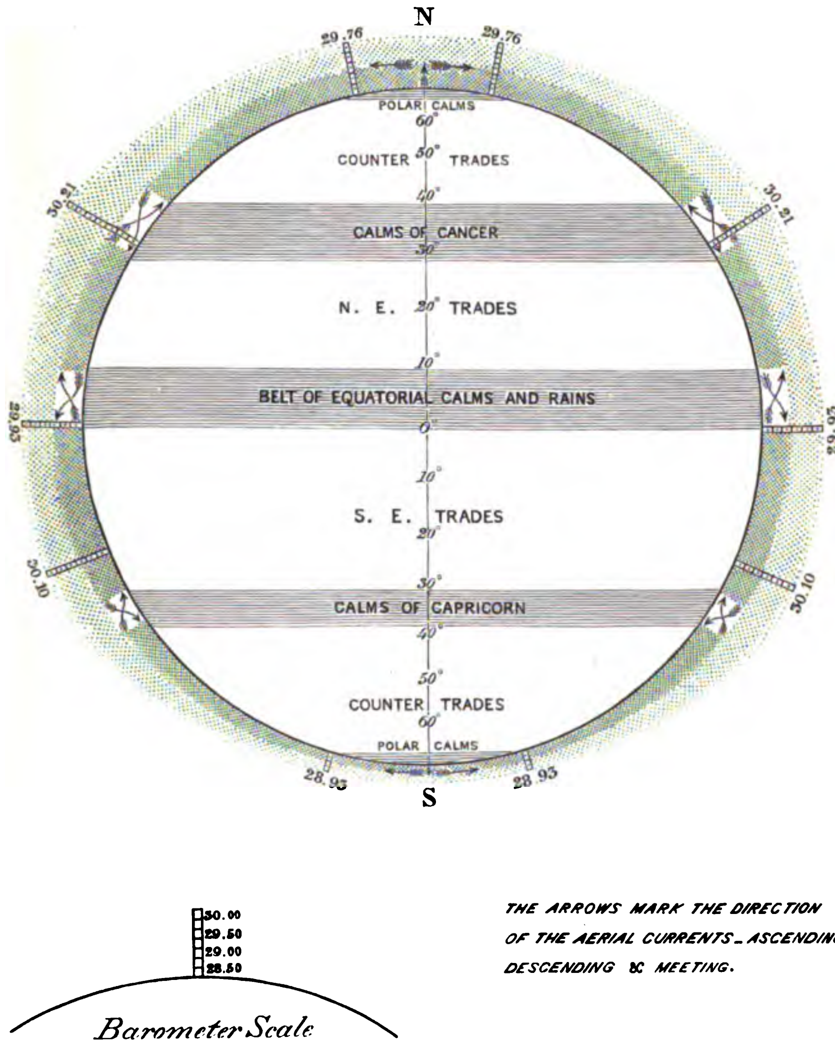
MAURY'S PROPOSED EXPLORATION ROUTE

COAST DISCOVERED BY LIEUT WILKES U.S.N.

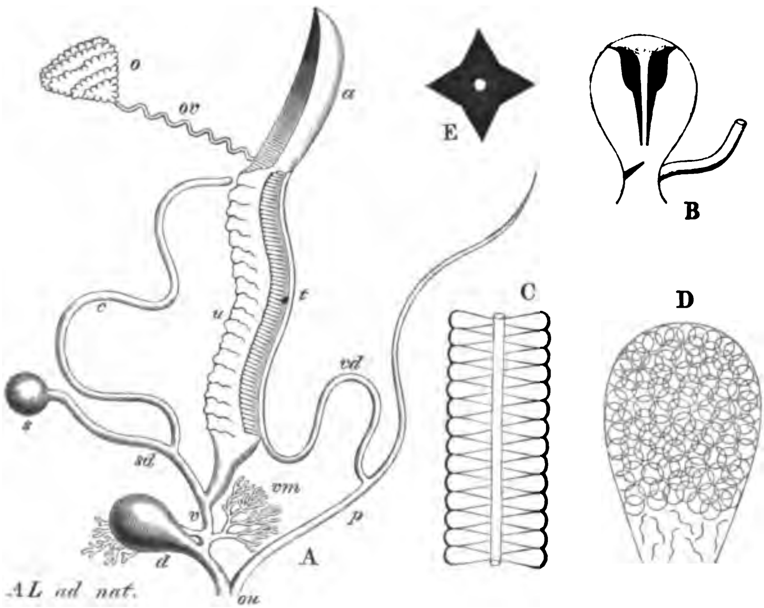
ROSS FURTHEST SOUTH 78° 10'. *

PROFILE OF THE ATMOSPHERE.

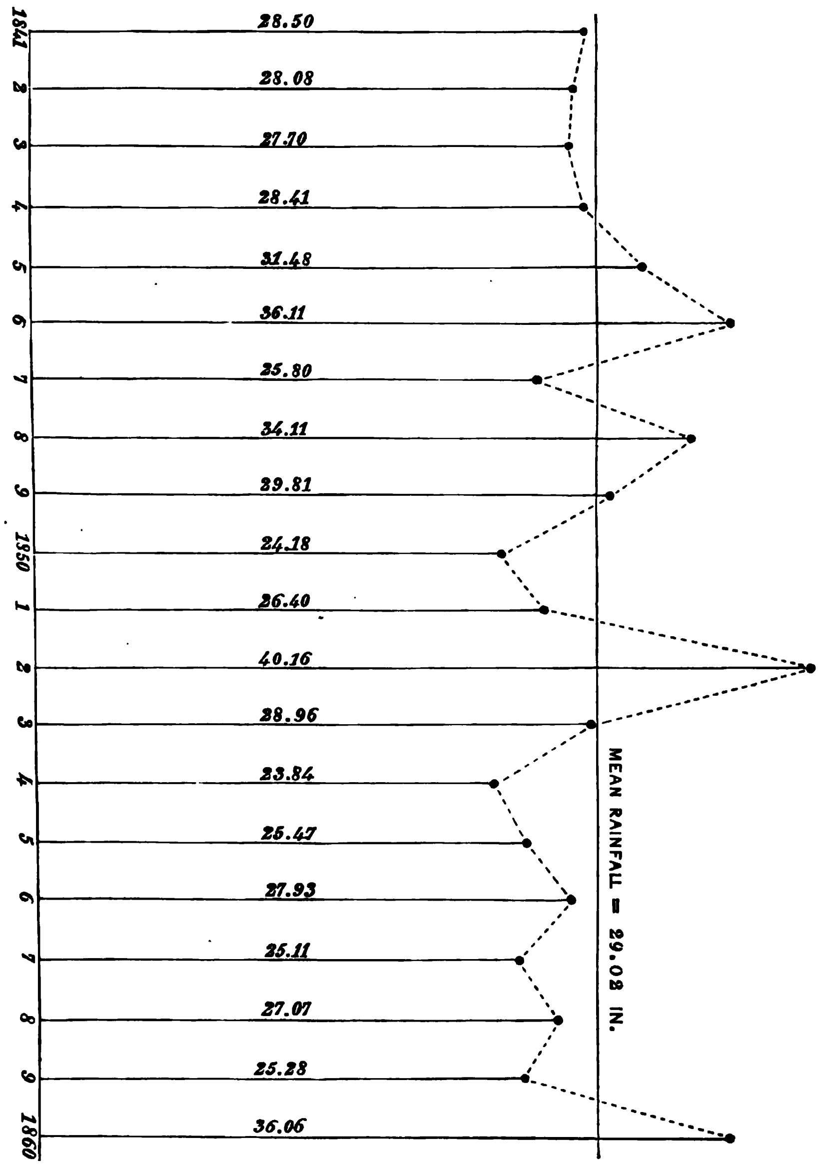
(FROM CAPT^N M. F. MAURY. U.S.N.)



THE ARROWS MARK THE DIRECTION OF THE AERIAL CURRENTS _ ASCENDING, DESCENDING & MEETING.



ANATOMY OF GENERATIVE SYSTEM OF HELIX ASPERSA AND HELIX HORTENSIS.



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6 36.11
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8 34.11
9 29.81
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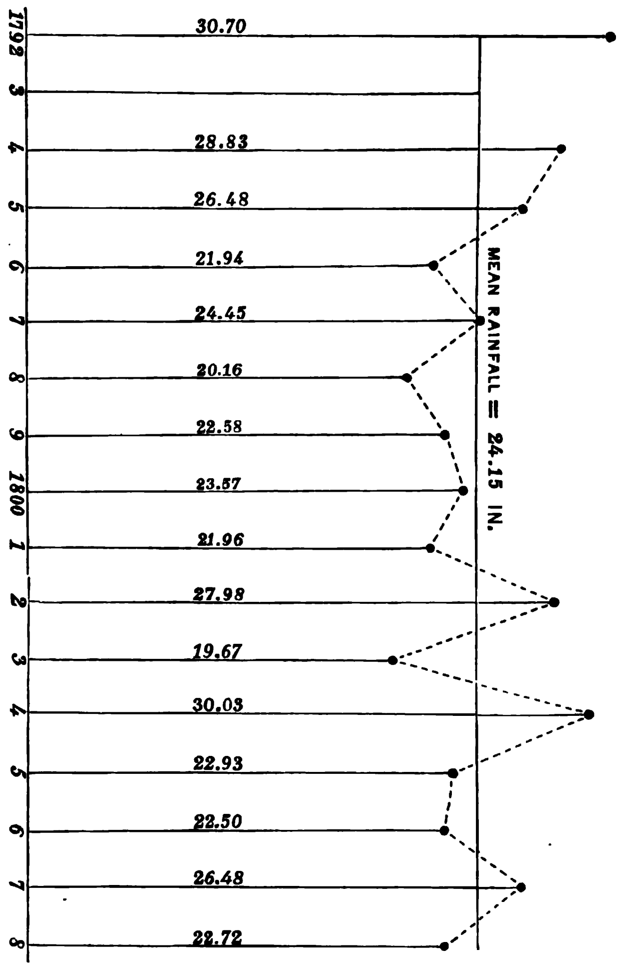
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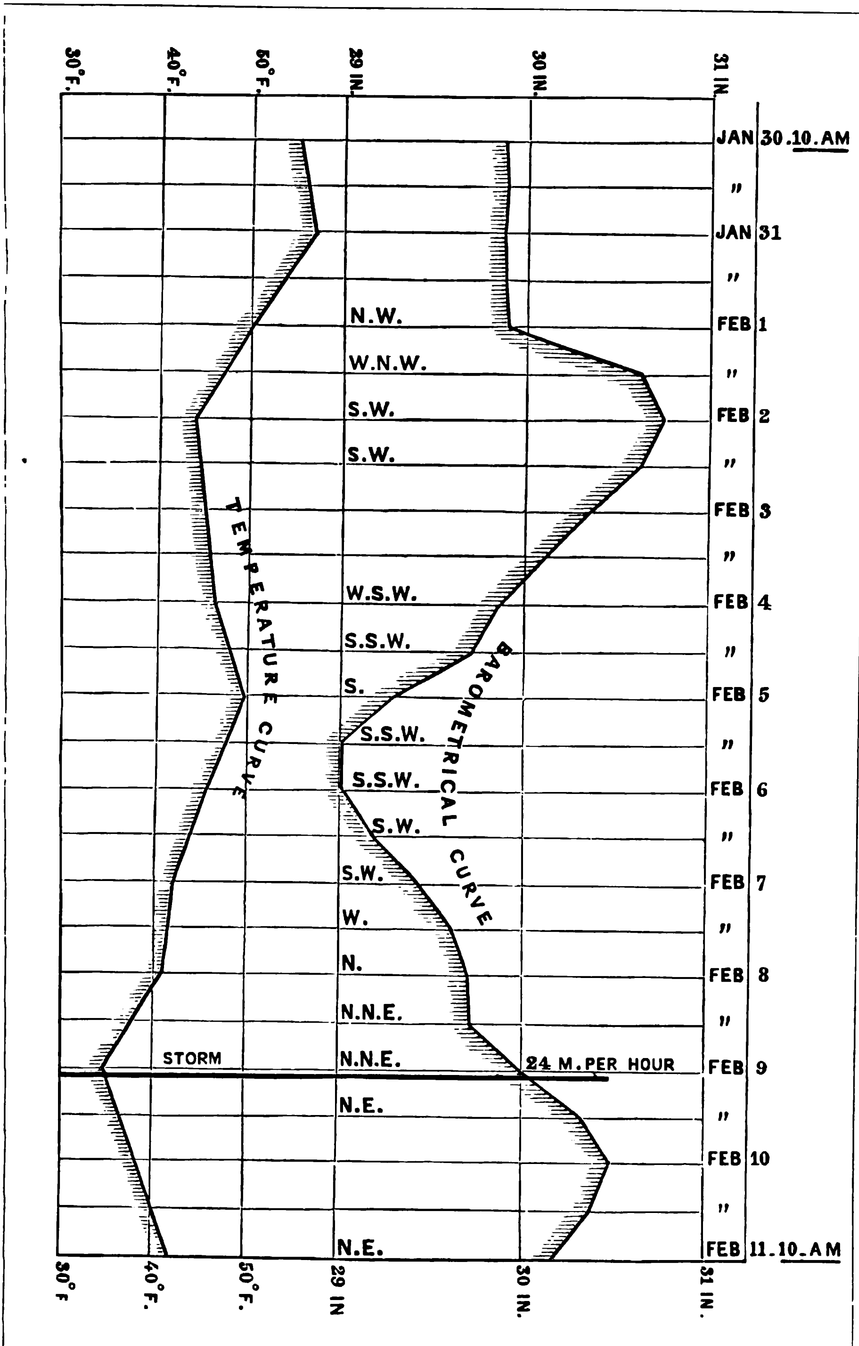
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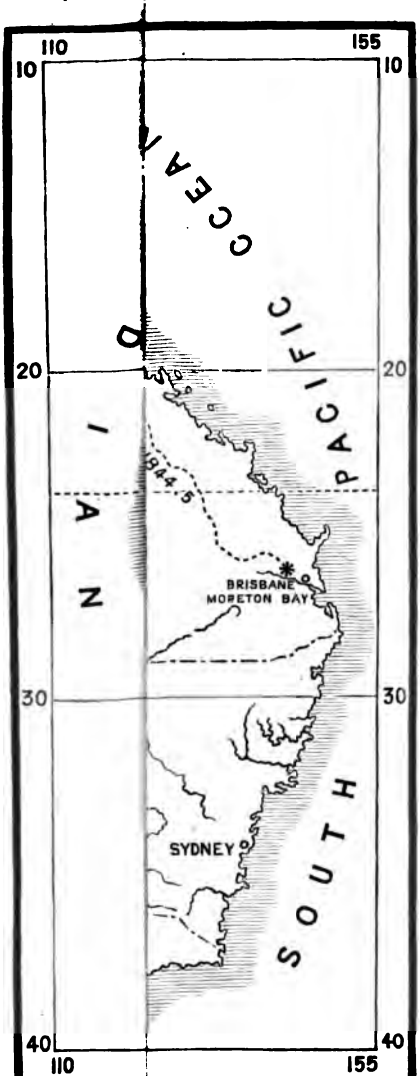
TEMPERATURE CURVE
BAROMETRICAL CURVE
STORM
24 M. PER HOUR



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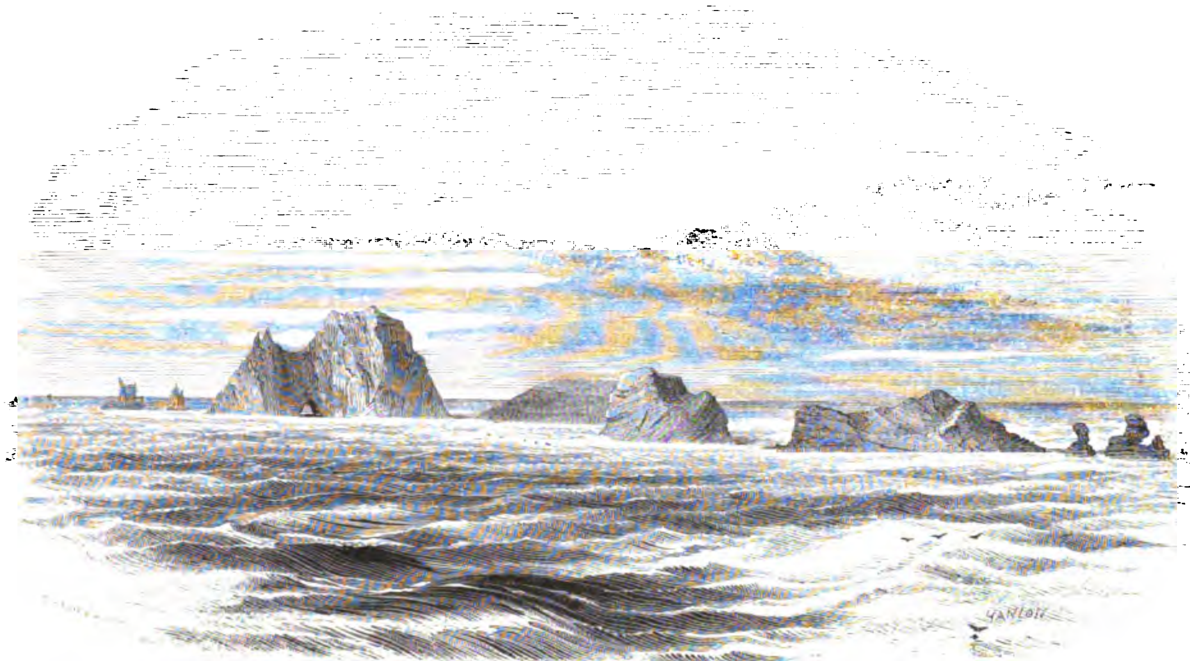
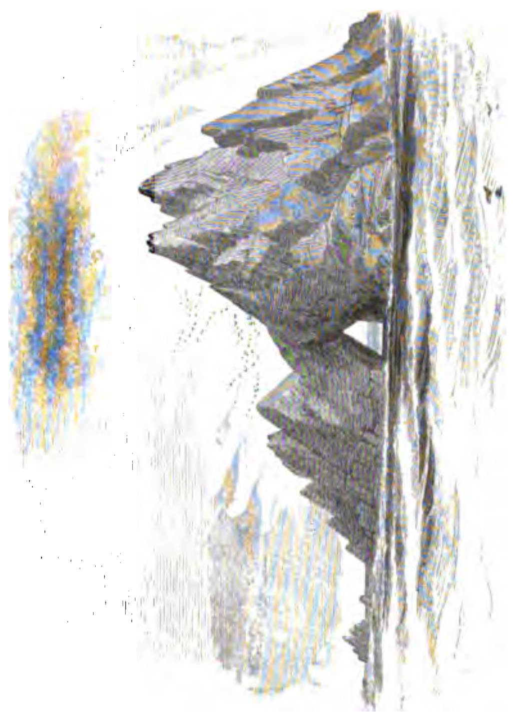


Tiraght Great Blasket. Innisnabroe. Innismacilaun. Western Blasket. Foze Rock.



The Tiraght,—bearing by Compass N.N.E.

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